DOCUMENT RESUME

ED 256 611 SE 045 545

TITLE Elementary Science Syllabus: Science Attitudes, Problem Solving, Skills, Science Content.
INSTITUTION New York State Education Dept., Albany. Div. of Program Development.
PUB DATE 85
NOTE 70p.; Several pages containing photographs may not reproduce well.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Biological Sciences; *Course Descriptions; Elementary Education; *Elementary School Science; Inquiry; Language Arts; *Physical Sciences; *Problem Solving; Process Education; Program Development; Program Implementation; Science Education; *Science Programs; Skills; Student Attitudes
IDENTIFIERS *New York

ABSTRACT

This four-part publication is designed to assist New York school personnel in designing local elementary science programs that will help students increase their scientific literacy. Part I addresses various topics related to implementing a local elementary science program, considering local planning, Regents goals, science instruction, time allotment, program evaluation, humane treatment of animals and birds, conservation day, and safety. Part II lists and defines goals for problem-solving, skills, positive science attitudes, and science content. Science content goals are specified for three age levels (ages 4-7: life/physical sciences; ages 7-9: life/physical sciences; ages 9-11: life/physical sciences and ecosystems) while the components of problem solving, skills (including inquiry, process, and language arts skills), and science attitudes are the same for all three levels. Part III contains an overview of three types of program activities (units, mini-units, and unit starters) and information on establishing a cross-reference between program activities and the science syllabus. Part IV is a series of appendices. They include a statement of Regents goals for elementary and secondary students for 1984, a list of elementary science goals and criteria, safety suggestions, a syllabus-program correlation chart for the three age levels, and information on developing programs at the local level. (JN)

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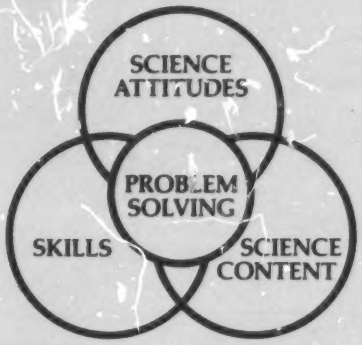

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The curriculum defined in this publication supports the State plan for Basic Skills and was printed, in part, with funds from ESEA Title I Basic Skills.

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FOREWORD

This publication has been prepared to assist administrators, curriculum specialists, science supervisors, classroom teachers, special education teachers and others responsible for implementing curriculum. How you use the publication will depend on your school district's plan for organizing the science program and your own role in the planning process.

District level or multidistrict planning teams should be the primary audience where more than one elementary school feeds to a junior high school or middle school. Building level teams can also provide the necessary planning when only one building is the focus for the district's elementary program. The keys to successful implementation of the syllabus are the collaboration and coordination of general education, special education and support staff.

The publication has four parts: implementation, syllabus, program activities, and appendices. It does not define content for specific grades. It does provide planning materials to help you examine your school's current science program and chart your own grade-by-grade approach to meet the syllabus requirements.

Production of the Elementary Science Syllabus would not have been possible without the extraordinary cooperation of the District Superintendents and their Boards of Cooperative Educational Services (BOCES) throughout the State. They were represented by their Curriculum Committee chaired by Freeman A. VanWickler, District Superintendent, Delaware-Chenango-Madison-Otsego BOCES. The elementary science revision project administration was conducted under the supervision of Richard E. TenHaken, District Superintendent, Monroe #2-Orleans BOCES.

The field review of the draft syllabus was conducted by Philip J. Pillsworth, Bureau of School and Categorical Programs Evaluation. James J. Brady and staff of the Bureau of Statistical Services selected the sample of schools, processed the data, and analyzed the results. Technical assistance was provided by John J. Stiglmeier and Leonard Powell, Information Center on Education, by John J. Temps, Planning and Support Services, and staff of the Division of Electronic Data Processing.

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INTRODUCTION

Our society becomes more scientifically and technically oriented each day. The issues and problems we face are increasingly complex. As a result, it becomes more and more difficult to resolve them. To deal with such complex issues and problems as adults, students must begin in the elementary grades to become informed decision makers and effective problem solvers. In brief, they must increase their scientific literacy.

Students increase their scientific literacy by developing skills and positive science attitudes and acquiring knowledge about the natural world. They demonstrate their increase in scientific literacy by using their skills, attitudes, and knowledge to solve problems appropriate for their age. This publication will guide you as you design a local elementary science program that will help your students increase their scientific literacy.

Part one of this publication deals with implementing your local elementary science program. It addresses the question: "What must we do to have a successful local elementary science program?" This question may help you focus your attack on the problems of implementation. The section is intended to help you identify and clarify the questions that relate to your specific problems of implementation.

Part two is the syllabus. It addresses the question "What elementary science should our students be learning?" The syllabus defines goals for problem solving, skills, positive science attitudes, and science content. The science content is specified for three age levels:

Level I — ages 4 through 7
Level II — ages 7 through 9, and
Level III — ages 9 through 11.

The components of problem solving, skills, and science attitudes are the same for all three levels. However, you should develop them to a progressively higher degree as students move from one level to the next.

Part three contains State criteria and recommendations for the local elementary science program. It addresses the question "How can I best teach elementary science?" An overview is included for three types of program activities, units, mini-units, and unit starters. Examples of these program activities are available in three separate publications. The elementary science supplements are published in looseleaf format for each of the three levels and are available on request from the State Education Department. A syllabus-program correlation chart is provided to help you establish a cross-reference between your program activities and the syllabus. The supplement for each level contains a complete syllabus-program correlation chart for all program activities included in that supplement.

Part four is a series of appendices. These contain supplementary information, legal requirements, suggestions, guidelines, and other material you may find useful as you use this publication to plan and implement your local elementary science program.

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PART I

New York Energy Education Project

IMPLEMENTING ELEMENTARY SCIENCE

. . . a successful elementary science program requires teamwork among educators in problem solving . . .

IMPLEMENTING ELEMENTARY SCIENCE

OVERVIEW

The elementary science syllabus provides goals, or learner outcomes, for students. The goals are based on Education Law, Regulations of the Commissioner of Education, Statement of Regents Goals for Elementary and Secondary School Students, and the tradition of successful practices statewide.

Your local elementary science program is the unique set of experiences that help your students meet the goals defined in the syllabus. Your program may be built upon a wide variety of activities and can include the use of manipulative materials, kits, out-of-class activities such as field trips, movies or other media materials, trade books, and textbooks. It may draw upon commercial, national, regional, State, and local resources. It may be unlike any other local elementary science program in the State, but each activity you design should achieve specific syllabus outcomes. This is a major consideration for you to make in developing your local program.

The syllabus is the common denominator for all elementary science programs statewide even as it gives you the flexibility you need to develop a program that is uniquely yours. You will be able to take full advantage of the special resources of your area and the special talents, interests, and backgrounds of your teachers. You will be able to design activities that address directly the special needs and talents of your unique group of students.

A second major consideration you should make is that your local elementary science program be part of a district science program. An individual teacher could use this publication to plan experiences that are excellent in and of themselves and that achieve specific syllabus goals. However, without an overall district program, those experiences are likely to be piecemeal and uncoordinated with other teachers' efforts. In that case, the long-range goals set by the school district, the syllabus, and the Regents are not as likely to be achieved. Information about planning a district science program is given in Appendix I: Program Development at the Local Level.

A third major consideration is that you should design your program to emphasize a hands-on approach to learning. Experiences should provide students with opportunities to interact as directly as possible with the natural world. This approach will allow students to practice problem-solving skills, develop positive science attitudes, learn new science content, and increase their scientific literacy.

PLANNING YOUR LOCAL PROGRAM

As local educators, administrators, and teachers, you share responsibility for providing an effective science program. The more you are able to work together to solve problems and the more you are able to coordinate your efforts, the more successful your program will be. Be sure that you include not only regular classroom teachers but also special education teachers and others responsible for implementing the syllabus.

Consider coordinating your planning efforts with planning teams from other school districts as well. You may be able to share services and trained personnel, giving each school district the benefit of resources it might not be able to afford on its own. In areas served by Boards of Cooperative Educational Services (BOCES), many such cooperative efforts can qualify for aid.

Once you have established your planning team, you will need to consider the following factors:

—planning for science instruction
—program management
—program content
—materials for instruction
—assessment and evaluation

Some of the problems you will need to consider are given below in the form of questions. You may need to identify many other questions in order to fully clarify the problem of implementing elementary science in your particular situation.

Planning for Science Instruction

- What is our current program?
- How does our current program compare with State requirements and recommendations?
- What changes do we need or want to make?
- What problems will we encounter if we make changes?

Program Management

- Who has the responsibility to teach the program?
- How do general and special education staff coordinate instruction to meet the needs of students with handicapping conditions?
- Who has the responsibility to supervise the program?
- What training do the teachers and supervisors need?
- What funds are available?
- How will we insure that students have first-hand experience through hands-on activity in the classroom, in the field, and in resource areas such as libraries?
- How do we ensure that handicapped students have equivalent access to the program content of the curriculum?

Program Content

- Which learning outcomes will we set for each grade level?
- What instructional topics will we use at each grade level?
- Which program activities will we use?

Materials for Instruction

- What materials do we have now?
- What modifications and adaptations to materials will be needed to meet the needs of students with handicapping conditions?
- What materials will we need to acquire?
- How will we organize our materials for maximum benefit?
- How will we insure that teachers always have the materials they need?

Assessment and Evaluation

- How will we measure student achievement?
- How will we measure program effectiveness?
- How will we ensure that students with handicapping conditions have access to alternative testing techniques?

STATE REQUIREMENTS & RECOMMENDATIONS

THE REGENTS GOALS

The Regents goals and subgoals appear in complete form in Appendix A. They are the major requirements for elementary and secondary education in New York State. Your local elementary science program should help your students achieve the Regents goals.

ELEMENTARY SCIENCE INSTRUCTION

The program of instruction for the State's schools is based on Education Law, Regulations of the Commissioner of Education, and the Regents goals, as well as the tradition of successful practices statewide.

Prekindergarten and Kindergarten Programs — These are a child's introduction to the world of school. Commissioner's Regulations 100.3-(a) state that "Learning activities in such programs shall include: ....participation in group projects...science and mathematical experiences." These programs present an opportunity for you to begin to develop the child's scientific literacy.

Grades 1-6 — The elementary schools of New York State are required to provide instruction in a number of subjects including science. The intent of this requirement is that a child receive regular exposure to all of the subject areas, including science, throughout the school year. (Commissioner's Regulations 100.3 (b) (1)).

TIME ALLOTMENT

Students in particular age ranges can benefit from exposure to science for the percentages of time shown in the table below. These percentages are stated for time spent exclusively on science. Many opportunities exist, however, to integrate science instruction with other parts of the school program. Thus, when reading and language activities are integrated with science, part of the time spent may be allocated to the reading and language arts time allotment and part to the science allotment. Recommended weekly percentages of time for science instruction are:

Level I — ages 4 through 7 years — 5%
Level II — ages 7 through 9 years — 5-10%
Level III — ages 9 through 11 years — 10%

Students with handicapping conditions must be provided access to the general education curriculum. The majority of students with disabilities have the intellectual potential to master the general education curriculum content. Providing such students with science curricula at the elementary level will better prepare these students for statewide testing programs and courses required for attaining a diploma. See Appendix H: Students with Handicapping Conditions, for additional information.

ELEMENTARY SCIENCE EVALUATION

There are many ways to evaluate student achievement in elementary science. Day-to-day evaluation in the classroom is the most comprehensive way. As the teacher, you can and should use a mixture of evaluation techniques such as oral questions and answers, written questions and answers, written assignments, performance tests, and teacher observation of classroom activity.

Evaluation at the building or district level usually involves paper-and-pencil tests. These are best suited to measuring cognitive outcomes. However, other evaluation techniques should be used by the district as well to determine learning outcomes in skills, science attitudes, and problem solving. Alternative testing techniques should be implemented as specified on the individualized educational program of students with handicapping conditions. When these techniques are used consistently throughout the total testing program, handicapped students are provided the opportunity to demonstrate their acquired knowledge and skills.

Effective May, 1989 the State will assess the local elementary science programs through the Program Evaluation Test in Science. This assessment, to be conducted by the end of the sixth grade, will determine how well the syllabus goals are being achieved by the local program. (Commissioner's Regulation 100.3 (b) (2)).

Elmira City School District

STATE REQUIREMENTS & RECOMMENDATIONS

HUMANE TREATMENT OF ANIMALS AND BIRDS

Education Law 809 stipulates that public elementary schools teach the humane treatment of animals and birds. You should carefully review program activities conducted in elementary science that could have impact on living animals and birds to determine the degree to which the activity adheres to the Guidelines for the Use of Vertebrate Animals in Elementary and Secondary School Programs of New York State, State Education Department, 1980, (Appendix F) and implements suggestions in the publication The Humane Treatment of Animals: A Guide for Elementary Teachers, State Education Department, 1975.

CONSERVATION DAY

Education Law 810 stipulates that instruction related to the conservation of natural resources of the State be provided to all public school students. Appropriate activities must be provided on the last Friday in April. That day is designated as Conservation Day or Arbor Day.

SAFETY RECOMMENDATIONS

—Make safety an integral part of the planning, preparation, and implementation of your science program.
—Make administrators, teachers, and students aware that they share responsibility for safety.
—Weigh continually the benefit of an activity against the level of risk in conducting it. (All activities have some level of risk.)
—Use common sense as your principal guide.
—Instill in students positive attitudes about safety.

Other information about safety is included in Appendix D: Safety Development of District Policies for Eye Protection: Suggested Guidelines, and in Appendix E: Some Safety Suggestions.

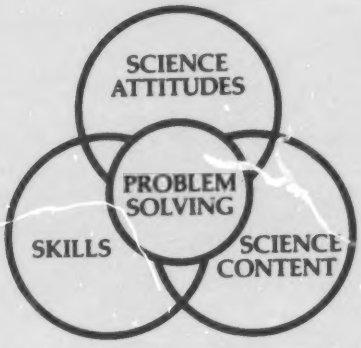
Elmira City School District

PART II

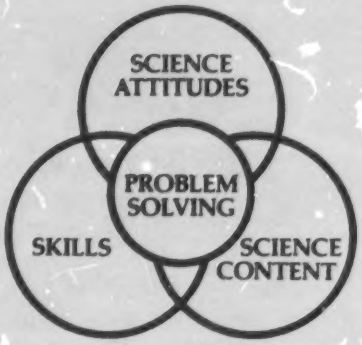
. . .the scientifically literate person is a problem solver. . .

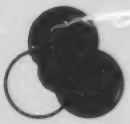
Elmira City School District

SYLLABUS



GOALS FOR ELEMENTARY SCIENCE INSTRUCTION





SYLLABUS GOAL: Students will demonstrate an increase in their scientific literacy.

This goal is consistent with the Regents goals for education in New York State and with the National Science Teachers Association goals for science education nationwide.

The Regents goals identify for students several learning outcomes such as thinking logically and creatively, learning methods of inquiry, acquiring knowledge in the natural sciences, and acquiring various attitudes necessary to function effectively in society. These goals are more fully described in Appendix A: Statement of Regents Goals for Elementary and Secondary School Students — 1984.

Characteristics of a scientifically literate person are described in Appendix B: Excerpts from a National Science Teachers Association Position Statement: Science-Technology-Society: Science Education for the 1980's.

Please study these appendices carefully before continuing with the rest of the syllabus.

PROGRAM GOAL: Students will solve problems effectively and with ease.

SCIENTIFIC LITERACY is demonstrated by the ability to use SKILLS, SCIENCE ATTITUDES and SCIENCE CONTENT to identify and solve science-related problems.

EFFECTIVE PROBLEM SOLVING is the ability to identify and solve science-related problems by applying appropriate skills systematically in ways that demonstrate positive science attitudes and an accurate understanding of science principles.

Elementary students are expected to solve problems appropriate for their age level.

PROGRAM GOAL: Students will apply skills systematically and with ease to solve problems.

SKILLS are the tools needed to solve problems. A carpenter must use specific tools in order to measure, saw, and nail together boards to build a house. In the same way, a problem solver must use specific skills in order to accomplish the various tasks involved in solving a problem.

The skills in this syllabus have been grouped as inquiry skills, which include mathematical skills, and language arts skills. The inquiry skills are used in science laboratory activities and for working with scientific data. Language arts skills are used to acquire scientific information through reading and listening and to communicate scientific information through writing and speaking.

PROGRAM GOAL: Students will develop positive science attitudes.

SCIENCE ATTITUDES are reflections of a person's values as those values relate to science. Values are a crucial component of the problem-solving process because they guide the person's behavior.

POSITIVE SCIENCE ATTITUDES are those attitudes which lead a person to:

—identify alternatives
—make the best choices, and
—act in ways that most enhance the quality of life both for the person and for others.

The positive science attitudes in this syllabus deal with expressions of feelings, understandings, and interests about nature and scientific knowledge; careful investigation and logical reasoning; and applications of scientific knowledge and methods of investigation for the benefit of others.

PROGRAM GOAL: Students will increase their understanding of science principles.

SCIENCE CONTENT includes a collection of principles about the natural world of living and nonliving objects and the events in which they are involved. The principles represent scientific knowledge that a person can use to help solve problems.

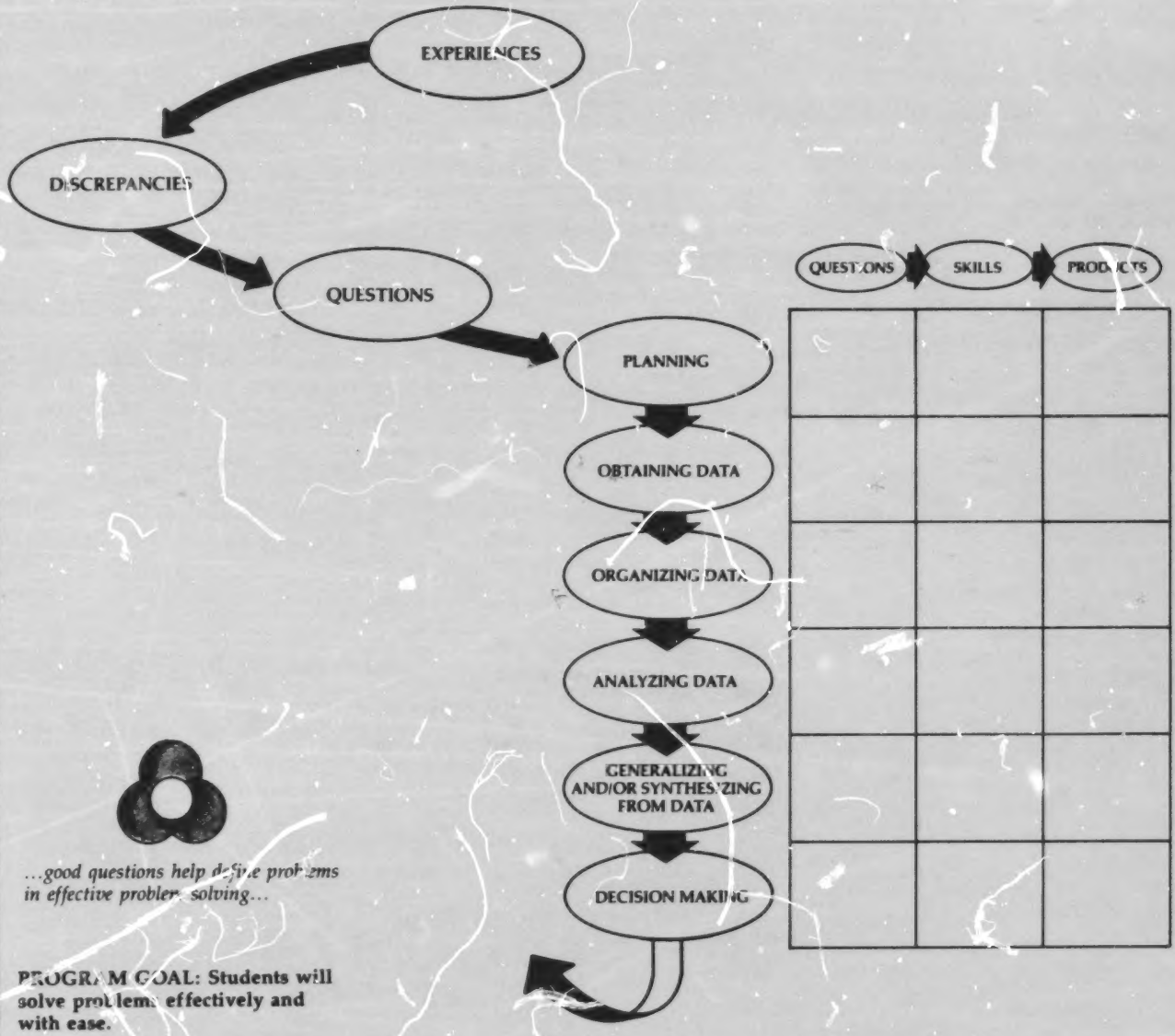
As a person's understanding of science principles increases, the person's ability to make informed decisions also increases.

This syllabus includes principles of both life science and the physical sciences. The principles are statements describing fundamental "truths" about nature as they are understood and generally accepted, based on scientific investigation. The principles included in the syllabus are appropriate for elementary school children.

The above goals and other criteria for elementary science education included in this syllabus are summarized in Appendix C: Elementary Science Goals and Criteria at a Glance.

Schenectady Community Headstart Program

PROBLEM DEFINING



...good questions help define problems in effective problem solving...

PROGRAM GOAL: Students will solve problems effectively and with ease.

Before a student can solve a problem, the student must recognize that there is a problem to be solved. To help your students recognize a problem, use their EXPERIENCES to make them aware of DISCREPANCIES. The discrepancies should lead them to raise QUESTIONS, and the questions will help them to define the problem.

EXPERIENCES can be both spontaneous events and teacher-planned activities. The natural world provides an inexhaustible pool of opportunities for students to interact directly with their environment. Experiences enrich a student's background, stimulate curiosity, and create a "need to know."

The experiences you choose for elementary science instruction should be ones that make a student aware of discrepancies.

Experiences appropriate for students in elementary science can include the use of both concrete and symbolic materials, but you should emphasize concrete materials. Direct experiences with concrete, hands-on materials enhance learning and lay the foundation for students to develop language and form concepts. Examples of these hands-on experiences are activities in which concrete materials, such as living things and other objects, can be examined and manipulated. Other activities include events such as out-of-class experiences. Examples of indirect experiences, those that rely on symbolic materials, include listening and speaking, reading and writing, and using mathematics symbols.

DISCREPANCIES are differences, inconsistencies, disagreements, or disharmonies that we encounter. A discrepancy becomes evident only when we have some prior experience or basis for comparison. Therefore, when you conduct an activity to make your students aware of a discrepancy, you must be sure that it is appropriate for their age level and prior experience.

In this syllabus, discrepancies have been grouped into six general categories (see below). An example for each is included.

—A goal to achieve without a means to achieve it.
- Raising a box that is too heavy to lift.

—A difference between what the student expects to observe and what the student actually does observe.
- A light bulb does not go out when the switch is turned off.

—A lack of knowledge — others may know the information, but the student does not.
- Seeds need moisture and heat to germinate.

—A difference between what the student has been told is true and what the student has already verified personally.
- Wood floats in water.

—A conflict (internal or external) between interpretations, opinions, attitudes, or values.
- Two students want to use the same piece of equipment at the same time.

—A difference between an existing set of conditions (what is) and desired set of conditions (what should be).
- A littered school playground needs cleaning.

QUESTIONS play a vital role in problem solving because they help to identify and define the problem and to guide the systematic search for a solution. Once a student recognizes a discrepancy, you should encourage the student to construct many questions about it. It is important that you teach students to construct precise questions. When a student has constructed a precise question, the student has more clearly identified the problem.

Questions are used in this syllabus to focus inquiry. The categories of questions and the focus of each include:

Category	Focus
who?	a person or group
what?	an object or event
when?	time
where?	a location
which?	a choice (alternative)
why?	a reason or explanation
how?	a procedure or process
what if?	speculation

New York Energy Education Project

MODEL FOR PROBLEM SOLVING

...an effective problem solver uses a systematic model...

PROGRAM GOAL: Students will solve problems effectively and with ease.

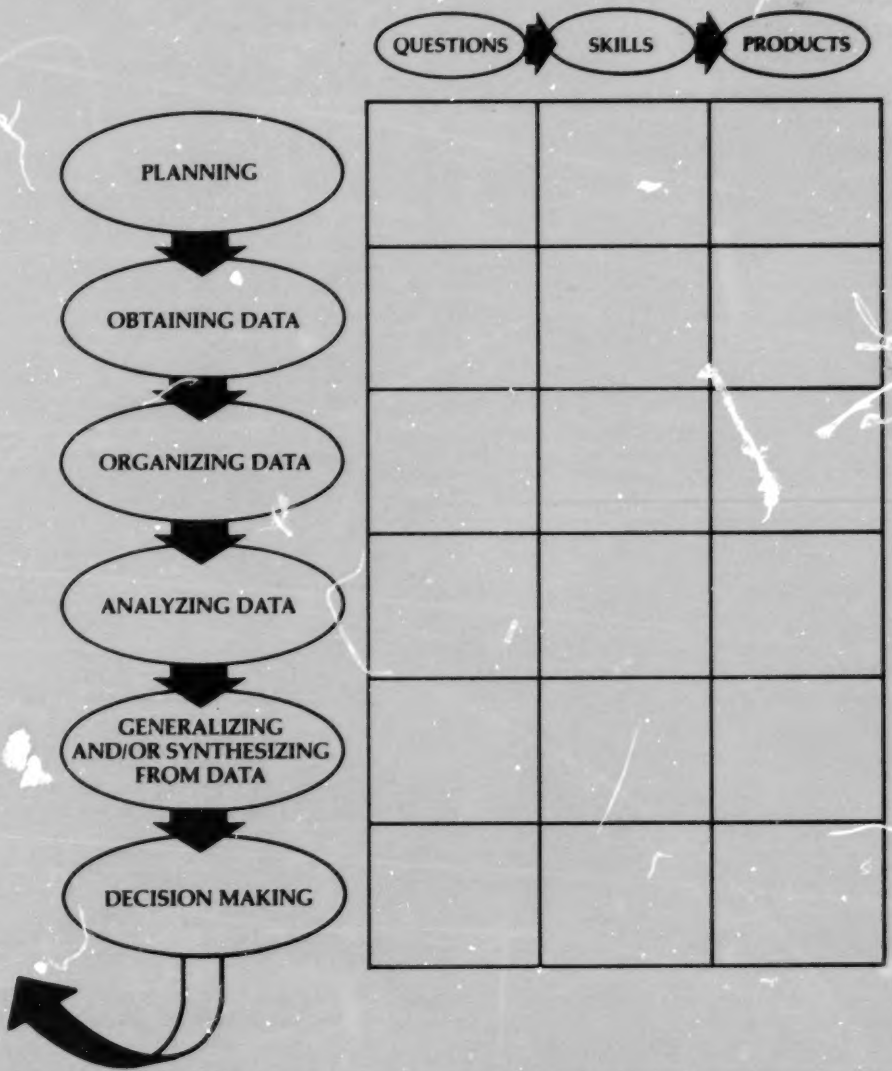
Once a student has identified a problem by constructing a precise question, the student can proceed with problem solving.

The model for problem solving is a sequence of steps. The steps begin with planning and progress to decision making. This is shown along the left side of the figure below. In the sequence a problem solver must act on the following tasks:

—constructing questions;
—identifying, selecting, and applying skills; and
—creating tangible products, which contain answers to the questions.

This is shown across the top of the figure below.

Since the model is organized into a sequence of steps with specific tasks for each step, you can isolate each step for instruction. Once a student learns the tasks for each step, the student will be able to use them, either deliberately or automatically, to solve new problems.



QUESTIONS

The problem solver should construct many precise questions that will help clarify the problem and the steps that must be taken to solve it. This may be done in a brainstorming-style activity. The student should view each precise question as a little piece of the problem to be solved. There is no need initially for the student to organize the questions. That task is part of the planning step.

SKILLS

The problem solver can obtain an answer to each precise question by applying appropriate skills (tools). Students should be taught to select and apply the best tools for the specific task implied by the question. The Skills section describes individual skills in detail.

PRODUCTS

The problem solver creates a tangible product by applying the appropriate skills to the specific task. For example, by applying the skill of recording data, the problem solver may create the tangible product of a chart or graph. The tangible product contains an answer to the question.

PLANNING is the initial step in the model for problem solving. In the Planning step, a problem solver uses a sequence of focus questions to construct and organize the precise questions. The focus questions are:

1. What is the problem?
2. What background information do I already have?
3. What new information do I need?
4. What procedure or sequence of actions do I need to follow?
5. How will I know when I have solved the problem?

Students should be taught that when they construct a plan, they must always assume that the plan may have to be revised in light of new information.

Good planning is an essential component of effective problem solving.

OBTAINING DATA is the second step in the model. In this step, the problem solver gathers data that may have an impact on the solution to the problem. The problem solver is guided by the focus question, "What new information do I need?" Quantitative as well as qualitative data may be needed.

The process of obtaining data depends heavily on use of the senses and/or extensions of the senses. Sensitivity to the sensory strengths and weaknesses of students requires attention during the process of obtaining data. The worth of the data obtained depends on the degree of accuracy and precision exercised by the person who obtains it. Therefore, to obtain good data, a problem solver must be accurate and precise.

Obtaining good data is essential to effective problem solving.

ORGANIZING DATA is the third step in the model. Here, the problem solver establishes some pattern of order or form with the data obtained. The problem solver is guided by the focus question, "In what useful way(s) can the information be organized?" It may be possible to organize the data many different ways. Thus, the form chosen should be considered tentative or temporary. During the next step of the model, the usefulness of the form will become apparent. If the form is not useful or adequate, the problem solver may need to change the plan or use a different form to organize the data.

Finding the best way to organize the data is very important in effective problem solving.

ANALYZING DATA is the fourth step in the model. It requires the problem solver to seek apparent patterns and relationships in the data, to recognize characteristics that suggest cause and effect, and to state inferences. The problem solver is guided by the focus question, "What useful analyses can be made of the organized information?" Analysis of the data is the foundation upon which to conduct the next step, Generalizing and/or Synthesizing from Data.

Analysis of data must be careful and reasoned in effective problem solving.

GENERALIZING AND/OR SYNTHESIZING FROM DATA is the fifth step in the model. Here, the problem solver creates conclusions or alternative choices (potential solutions to the problem) to use in the next step, Decision Making. The problem solver is guided by the focus question, "What can be drawn from the analyses of information?" The conclusions or alternative choices may lead to the same solution (convergent thinking), or they may suggest a number of different solutions (divergent thinking).

Sound alternative choices become the basis for informed decision making in effective problem solving.

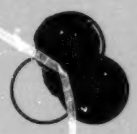
DECISION MAKING is the final step in the model for problem solving. In the decision making step, a problem solver uses a sequence of focus questions to arrive at a decision. The focus questions are:

1. What decision needs to be made?
2. What are the alternative choices and the reasons for each?
3. What are the consequences of each alternative?
4. Who will be affected by each possible choice and in what way?
5. What values are directly related to each choice, and how do they relate to it?
6. Which choice is the best choice?

The decision may lead directly to the solution to the problem. It may point to new directions in pursuit of the solution, or it may suggest new problems to be solved. In any case, the decision should lead to action, and the action should be freely chosen by the problem solver.

In effective problem solving, the problem solver makes an informed decision by working from a rational base of data to make the best choice.

SKILLS



...skills are the tools used in effective problem solving...

PROGRAM GOAL: Students will apply skills systematically and with ease to solve problems.

Skills are the tools needed to solve problems. Working from a plan, a problem solver selects the correct "tools for the job" and uses them to accomplish specific tasks. An effective problem solver must be expert in using the required skills.

A student needs to learn the appropriate use of each skill, and needs plenty of opportunities to apply each skill in realistic situations.

INQUIRY SKILLS include those skills used to:

—obtain data through scientific investigation,
—organize the data into a useful form,
—analyze the data,
—generalize and/or synthesize from the data, and
—make decisions.

Inquiry skills enable a scientific investigator to identify facts, and facts are the raw material a person uses to understand principles of science

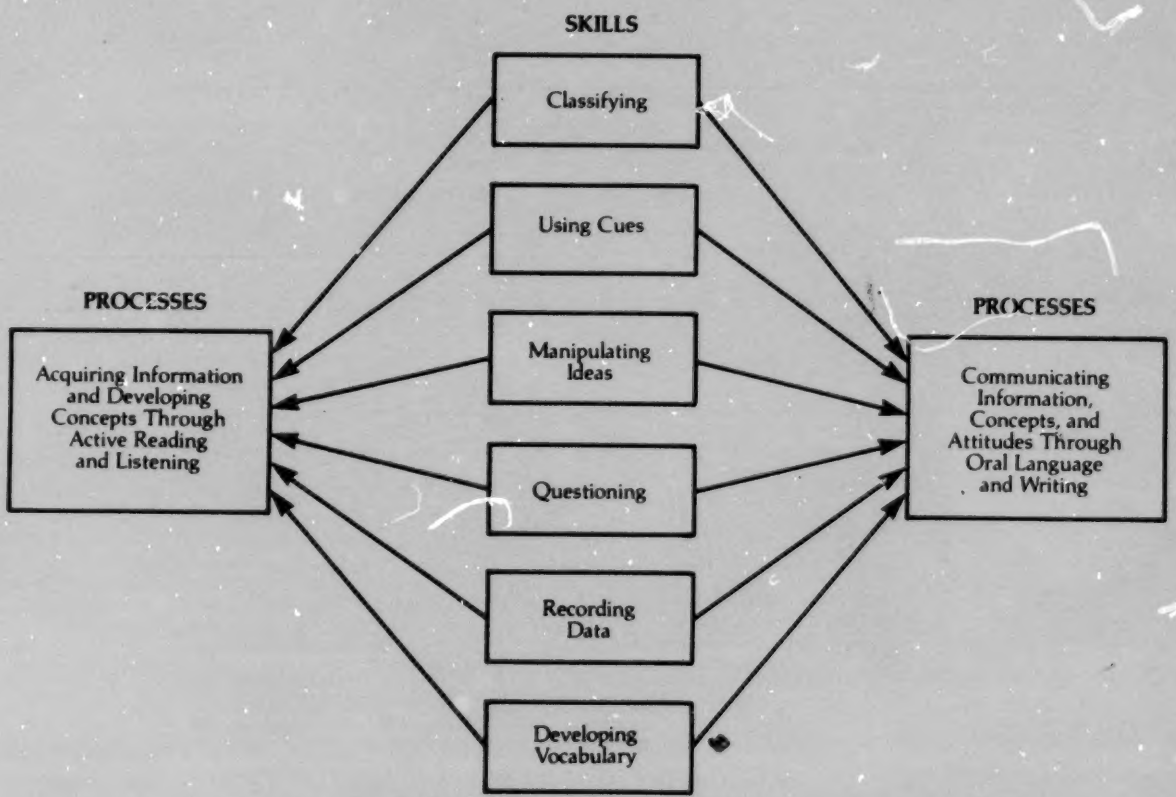
SKILLS
*CLASSIFYING
CREATING MODELS
FORMULATING HYPOTHESES
GENERALIZING
IDENTIFYING VARIABLES
INFERRING
INTERPRETING DATA
MAKING DECISIONS
MANIPULATING MATERIALS
MEASURING
OBSERVING
PREDICTING
*RECORDING DATA
REPLICATING
USING NUMBERS

LANGUAGE ARTS SKILLS enable a person to acquire and communicate information. A person uses reading and listening to acquire information and develop concepts. The person uses speaking and writing to communicate information, concepts, and attitudes to others. In the study of science, language arts skills and processes are used to:

—ask questions and develop plans;
—acquire new facts, meanings, and concepts;
—share observations;
—synthesize information from a variety of sources;
—make critical judgments; and
—solve problems.

The skills and processes listed in this syllabus are those an elementary school student needs to solve problems effectively. The lists are alphabetical and a three-column format is used. The skill or process is listed in the left-hand column. A definition is in the middle column, and an example of the behavior a student might demonstrate when applying the skill or process is in the right-hand column.

LANGUAGE ARTS SKILLS/PROCESSES



INQUIRY SKILLS

SKILL	DEFINITION	EXAMPLE – The skill is being demonstrated if the student is:
*CLASSIFYING	Arranging or distributing objects, events, or information representing objects or events in classes according to some method or system.	• Taking objects such as buttons from a mixed collection and placing them in groups by color, number of holes, or shape; or arranging them in order according to size.
CREATING MODELS	Displaying information by means of graphic illustrations or other multisensory representations.	• Drawing a graph or diagram; constructing a three-dimensional object; using a tape recording; constructing a chart or table; or producing a picture or photograph that illustrates information about the melting of ice cubes.
FORMULATING HYPOTHESES	Constructing a statement that is tentative and testable about what is thought likely to be true based on reasoning.	• Making a statement to be used as the basis for an experiment: "If one ice cube is placed in water and another placed in air at the same temperature, then the ice cube in water will melt faster."
GENERALIZING	Drawing general conclusions from particulars.	• Making a summary statement following analysis of experimental results: "Ice melts faster in water than in air when both air and water are at the same temperature."
IDENTIFYING VARIABLES	Recognizing the characteristics of objects or factors in events that are constant or change under different conditions.	• Listing or describing the factors that are thought to, or would, influence the rate at which an ice cube melts in air and in water, such as: original temperature of water and air, size of the ice cube, or volume of water and air.
INFERRING	Making a conclusion based on reasoning to explain an observation.	• Stating that heat caused the melting of an ice cube that had been placed in water.
INTERPRETING DATA	Analyzing data that have been obtained and organized by determining apparent patterns or relationships in the data.	• Studying a graph, chart, or table of data collected about melting ice cubes and noting that smaller ice cubes melt faster than larger ones.
MAKING DECISIONS	Identifying alternatives and choosing a course of action from among the alternatives after basing the judgment for the selection on justifiable reasons.	• Identifying alternative ways to store ice cubes to avoid causing them to melt; analyzing the consequences of each alternative such as the cost, the effect on other people or the effect on the environment; using justifiable reasons as the basis for making the choice; and choosing freely from the alternatives.

*Denotes a skill also listed in the Language Arts Skills.

SKILL	DEFINITION	EXAMPLE – The skill is being demonstrated if the student is:
MANIPULATING MATERIALS	Handling or treating materials and equipment skillfully and effectively.	• Arranging equipment and materials needed to conduct an investigation of the melting rate of ice; pouring liquids from one container to another; or carrying a balance or adjusting it for use.
MEASURING	Making quantitative observations by comparing to a conventional (or nonconventional) standard.	• Using a clock to count the number of seconds needed for an ice cube to melt; using a thermometer to determine the final temperature in degrees Celsius of the melted ice cube; or weighing ice cubes on a simple balance using paper clips as a standard.
OBSERVING	Becoming aware of an object or event by using any of the senses (or extensions of the senses) to identify properties.	• Looking at a melting ice cube to determine its changing shape; feeling water from an ice cube to determine its slipperiness or coldness; or using a thermometer to determine the coldness of the water.
PREDICTING	Making a forecast of future events or conditions expected to exist.	• Stating, "An ice cube whose weight is twice that of another ice cube will require twice the time to melt."
*RECORDING DATA	Collecting bits of information about objects and events which illustrate a specific situation.	• Taking notes; making a list or outline; recording numbers on a chart or graph; tape recording; taking photographs; or writing numbers of results of observations and measurements in an investigation, such as recording the number of cubic centimeters of water formed as an ice cube melts over time.
REPLICATING	Performing acts that duplicate demonstrated symbols, patterns, or procedures.	• Operating a balance scale or using a thermometer following procedures previously demonstrated or modeled by another person.
USING NUMBERS	Applying mathematical rules or formulas to calculate quantities or determine relationships from basic measurements.	• Computing the average time for a 10 cubic centimeter ice cube to melt.

LANGUAGE ARTS SKILLS

SKILL	DEFINITION	EXAMPLES — The skill is being demonstrated if the student is:
CLASSIFYING	Classifying involves the distribution of information into categories according to some system.	• Sorting, grouping, labeling, ordering, or sequencing bits of information in terms of similarities and differences.
DEVELOPING VOCABULARY	Specialized terminology and unique use of common words in relation to a given topic need to be identified and given meaning.	• Using context clues, working definitions, glossaries or dictionaries, word structure (roots, prefixes, suffixes), and synonyms and antonyms to clarify meanings.
MANIPULATING IDEAS	Paraphrasing, summarizing, and outlining are ways to manipulate ideas that can increase one's comprehension.	• Paraphrasing: Substituting and reordering words to create a new statement of equal accuracy to one encountered through listening or reading. • Outlining: Organizing or charting information from an investigation using key words and phrases, main ideas, and details. • Summarizing: Constructing a concise statement condensing information, or organizing data from an investigation.
QUESTIONING	Questions serve to focus inquiry, determine prior knowledge, and establish purposes or expectations for an investigation. An active search for information is promoted when questions are used.	• Using what is already known about a topic or concept to formulate questions for further investigation; hypothesizing and predicting prior to gathering data; or formulating questions as new information is acquired.
RECORDING DATA	Observations are often collected in the rough form of notes from an oral presentation, reading, observation, or experiment. These need to be translated into retrievable bits of information by making clear, concise, and accurate records.	• Constructing charts, tables, graphs, diagrams, lists, or outlines.
USING CUES	*Key Words and Symbols* convey the significant meaning in oral and written messages and often signal the organization of ideas and their relationships.	• Listing or underlining words and phrases which carry most important details expressed by the speaker or writer; relating key words to each other to express a main idea or major concept.
	Organizational Patterns facilitate comprehension of major ideas and concepts.	• Identifying signal words or phrases which indicate patterns of sequence, comparison and contrasts, cause and effect relationships, or order of significance.
	Graphic Features such as maps, charts, tables, graphs, and diagrams facilitate comprehension by clarifying textual information. Headings and subheadings are used to highlight topics discussed by the writer.	• Using illustrations and charts to augment or clarify textual information.
	Reference Features such as index, table of contents, glossary, and appendix contain useful information which facilitate comprehension by the reader.	• Using the index, table of contents, glossary, and appendix to locate or expand upon data provided in the text.

LANGUAGE ARTS PROCESSES

PROCESSES	DEFINITION	EXAMPLES — The process is being demonstrated, for example, if the student is:
ACQUIRING INFORMATION AND DEVELOPING CONCEPTS THROUGH ACTIVE READING AND LISTENING	*Developing Concepts* A concept is an abstract or generic idea generalized from particular examples of objects or events. Concepts are often designated by a name or symbol. Concepts are developed, modified, and refined as the student gathers data and classifies information to identify key ideas.	• Organizing information and data to locate or devise a tentative operational definition of the concept. • Identifying attributes or characteristics of the concepts which are always true. • Discriminating between examples and nonexamples of the concept. • Recognizing analogous relationships between similar concepts.
	Active Listening and Reading Listening and reading are essential for acquiring scientific knowledge, solving problems, and developing new concepts. Active listening and reading enable students to process and act upon information in relation to a specific problem being pursued.	• Locating information and using it in light of the purposes established for investigation. • Identifying major ideas and supporting details related to the topic being studied. • Solving problems as a result of information acquired through reading and listening. • Carrying out an experiment based upon printed or oral directions.
COMMUNICATING INFORMATION, CONCEPTS, AND ATTITUDES THROUGH SPEAKING AND WRITING	*Communicating Through Speaking* Inquiry and problem-solving offer many opportunities for students to interact verbally at various stages of the learning process. Students may share results of investigations orally or collaborate on solving problems and gathering data.	• Participating in brainstorming or hypothesizing as a prelude to an investigation. • Formulating initial or follow-up questions in the study of a topic. • Summarizing data and reporting informally, interpreting findings, or offering conclusions in an investigation. • Questioning, challenging, or refuting previous findings as a result of new or conflicting information.
	Communicating Through Writing Writing can be used by students to organize and share their ideas. Steps in the writing process include: 1. Prewriting — In science, the writer focuses on personal and classroom experiences to gather thoughts, ideas, feelings, image associations, observations, and other sensory impressions to establish the content or substance. 2. Drafting — The writer puts thoughts on paper with a purpose or audience in mind. 3. Revising — The writer revises an earlier draft to make it more effective. 4. Editing — The writer checks the final draft for mechanics. 5. Publishing — The writer shares the material with others.	• Actively engaging in the following stages of the writing process: 1. Participating in activities such as brainstorming, defining a problem, posing questions, and making lists, charts or notes. 2. Writing a draft which addresses itself to an audience, reflects the purpose and contains the intended ideas for later elaboration or refinement. 3. Rewriting a draft to more effectively convey ideas by adding, deleting, substituting, and rearranging words and phrases. 4. Reviewing subsequent drafts for spelling, word choices, capitalization, sentence structure, variety, coherence, and style. 5. Sharing written material includes activities such as producing a single report that might be catalogued in a special collection in the library or producing an article for the school newspaper.

MODEL FOR PROBLEM SOLVING (SAMPLE)

STEPS	FOCUS QUESTIONS/QUESTION STEMS
	1. What is the problem? 2. What background information do I already have? • What do I already know about ...? 3. What new information do I need? 4. What procedure or sequence of actions do I need to follow? • How can I find what I need to know about ...? 5. How will I know when I have solved the problem?
	What information is needed? • What are the properties of ...? • What are the names of ...? • What kinds of ...? • How long, wide, big ... is it? • How much does it weigh? • What color is it? • How hot is ...?
	In what useful way(s) can the information be organized? • Which ones belong to this group? • In what order do these ... belong? • What categories are there? • How can this be graphed? • What is the result of this ... calculation?
	What useful analyses can be made of the organized information? • In what ways does ... compare/contrast with ...? • What seemed to be the effect of ...? • What seemed to cause ...? • What must have been the pattern (sequence) of events? • What factors (variables) are involved? • What assumptions were made?
	What can be drawn from the analyses of information? • How can I explain ...? • How can I show I need to ...? • What is the principle of ...? • If this continues, then what is likely to happen? • What can I predict? • What might happen if I ...? • What model shows what we know about ...? • What new problems does this suggest? • How does ... apply to ...?
	1. What decision needs to be made? 2. What are the alternative choices and the reasons for each? 3. What are the consequences of each alternative? 4. Who will be affected by each possible choice and in what way? 5. What values are directly related to each choice, and how do they relate to it? 6. Which choice is the best choice?

SKILLS	PRODUCTS
• Communicating information • Creating models • Formulating hypotheses • Manipulating ideas • Predicting • Questioning • Recording data • Using cues	1. A statement of the problem 2. List of facts (background information) 3. List of questions (related to later steps in the process) 4. Sequential plan (a list of tasks, student assignments, and times for completion) 5. Sketch or description of the expected (predicted) final product
• Acquiring information • Developing vocabulary • Manipulating materials • Measuring • Observing • Recording data • Using cues • Using numbers	• Collections • Counts • Definitions • Lists • Photographs • Sketches • Tape recordings
• Classifying • Communicating information • Creating models • Manipulating ideas • Manipulating materials • Replicating • Using numbers	• Calculations or computations • Charts, tables • Diagrams, scale drawings • Graphs • Groups, categories of information • Outline • Sorted objects
• Identifying variables • Inferring • Interpreting data • Manipulating ideas • Using cues	• Description of a pattern or sequence • List of variables • Statements of cause and effect relationships • Statements of similarities and differences • Summary
• Acquiring information • Communicating information • Creating models • Formulating hypotheses • Generalizing • Manipulating ideas • Predicting • Questioning	• A model or simulation • A new hypothesis • A new prediction, problem, theory • Applications to new situations • Statements of principles • Statements which accept or reject hypotheses • Statements which confirm or do not confirm predictions • Written report
• Acquiring information • Communicating information • Making decisions • Manipulating ideas • Questioning	1. Statement of the decision to be made 2. List of alternative choices, supported by reasons 3. List of consequences of each alternative 4. List of persons directly affected by each choice and the way each is affected 5. List of values related to each choice supported by statements of how the values relate 6. A personal choice, supported by defendable reasons for the choice

SCIENCE ATTITUDES

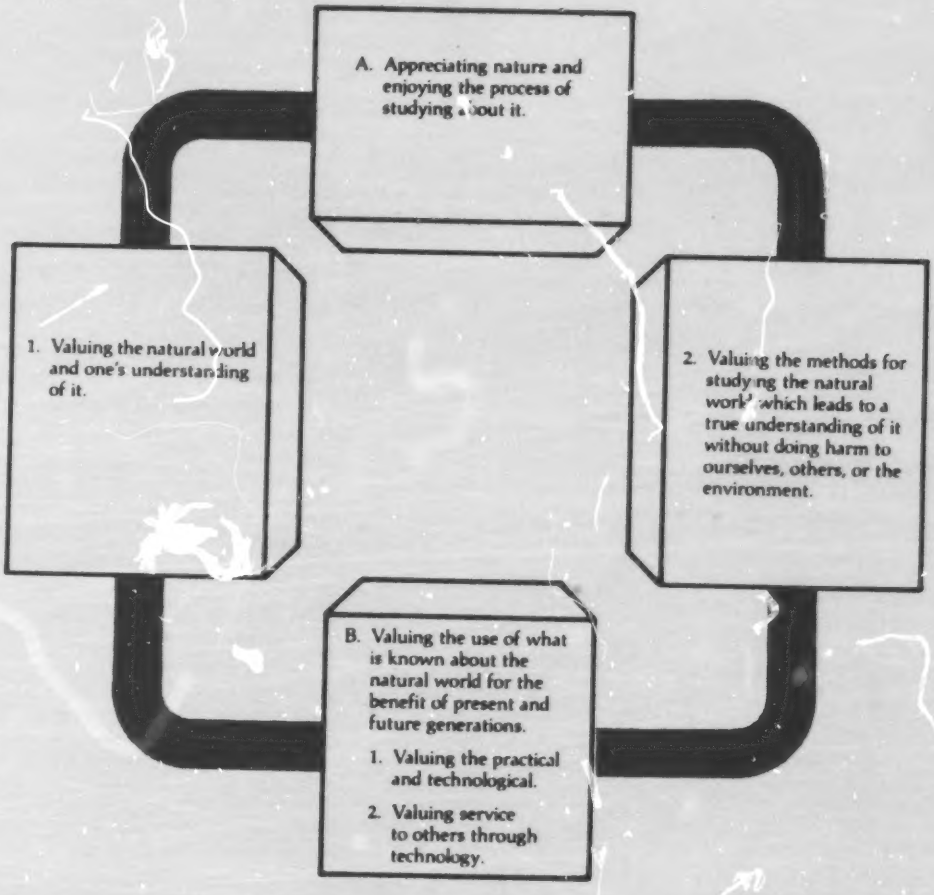
...an effective problem solver expresses positive science attitudes...

PROGRAM GOAL: Students will develop positive science attitudes.

Students can increase their capacity to appreciate nature and enjoy the process of studying about it. This is the most encompassing positive science attitude for you to help students develop. You can nurture this attitude by helping your students develop more specific positive science attitudes about the natural world itself, about methods for investigating the natural world, and about applying knowledge and methods of investigating for the benefit of others.

This relationship of the most encompassing positive science attitude to the more specific ones is shown in the figure below.

The general pattern throughout the science attitudes section is to develop more encompassing positive attitudes by developing more specific ones.


A. Appreciating nature and enjoying the process of studying about it.
1. Valuing the natural world and one's understanding of it.
2. Valuing the methods for studying the natural world which leads to a true understanding of it without doing harm to ourselves, others, or the environment.
B. Valuing the use of what is known about the natural world for the benefit of present and future generations.
1. Valuing the practical and technological.
2. Valuing service to others through technology.

SCIENCE ATTITUDES (STATEMENTS)

SCIENCE ATTITUDE STATEMENTS

The statements presented on pages 22–23 are positive science attitudes. A student must express positive science attitudes to solve problems effectively. As a student develops effectiveness at solving problems, the student will also develop more positive science attitudes. The statements of positive science attitudes are accompanied by examples of personal behavior that demonstrate the attitude. A student who demonstrates underlying positive attitudes is also demonstrating more encompassing positive attitudes. Thus, a student "marveling at observations made about nature" (see A-1.11) and "admiring beauty in the natural environment" (see A-1.12) is also "appreciating the natural world" (see A-1.1).

DEVELOPMENT OF ATTITUDES

Attitudes evolve gradually and become more stable as experiences reinforce them. Attitudes become more generalized as a person considers and acts upon them in ever more complex situations. Therefore, while this syllabus provides one set of attitude statements for students of all elementary school ages, the experiences and situations in which a student considers and acts upon those attitudes should increase in complexity as the student grows older.

VALUES, ATTITUDES, DECISION MAKING, AND PROBLEM SOLVING

In many (perhaps most) situations, a person can act in ways that are consistent with all values the person holds. However, there may be instances when it is not possible for a person to act in a manner consistent with one value without being inconsistent with another. For example, a person who values truthfulness in reporting research results (A-2.25) may have a conflict with respecting the values of others (A- 2.26). Such a dilemma requires a person to weigh the conflicting attitudes and search for courses of action most consistent with all values held. Often the person must reach a compromise. The nature of the compromise and of subsequent actions chosen vary with the particular situation and especially with the weightings a person gives to the conflicting values.

Classroom instruction should foster the positive science attitudes, appreciations, and values stated in this syllabus. However, their relative importance in a given situation must be left to each student to consider. Personal action must be freely chosen by a student within the constraints of society.

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A. APPRECIATING NATURE AND ENJOYING THE PROCESS OF STUDYING ABOUT IT.

1. Valuing the natural world and one's understanding of it.

1.1 Appreciating the natural world.

1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. For example:
- Marveling at observations made about nature.
- Expressing recognition of how much there is to study about nature.
- Acknowledging the differences, similarities, and interdependencies in nature.

1.12 Appreciating the natural world as an essential resource in fulfilling human needs, both physical and aesthetic. For example:
- Caring for flowering and food plants.
- Conserving natural resources.
- Admiring beauty in the natural environment.

1.2 Respecting life in the natural world.

1.21 Respecting each individual life as precious to the individual and others. For example:
- Seeing to it that plants and animals are properly cared for.
- Not killing plants and animals without justifiable reason.

1.22 Respecting each present form of life as the only source for the continuation of that form. For example:
- Expressing concern for endangered species.

1.23 Accepting the aging process of all living things as continuous and natural. For example:
- Expressing realization that all living things grow older and eventually die.

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2. Valuing methods for studying the natural world that lead to a true understanding of it without doing harm to ourselves, others, or the environment.

2.1 Valuing skepticism, careful investigation, and logical reasoning as means of increasing one's understanding of the natural world.

2.11 Accepting information and ideas about the natural world as uncertain and valuing verification and supporting reasons. For example:
- Questioning ideas presented in books or through other media.
- Testing claims through direct observation, experimentation, and reason.

2.12 Welcoming the unknown or the ambiguous and accepting contradictory or tentative ideas as starting points for increasing one's understanding of the natural world. For example:
- Becoming quickly involved in trying to resolve discrepancies in observations or between observations and explanations.
- Posing problems and puzzles.

2.13 Valuing original insights, uncertain inferences, and flexible and unconventional thinking as sources of potentially useful ideas. For example:
- Paying careful attention to new ideas.
- Presenting original ideas.
- Willing for the sake of testing an argument to accept temporarily an assumption that one believes is false.
- Understanding and accepting alternative strategies for accomplishing the same task.

2.14 Valuing careful, systematic investigation as useful in resolving issues. For example:
- Planning investigations carefully before beginning.
- Questioning the validity of experiments.

2.15 Valuing logical reasoning as a means of testing and weighing the validity of ideas. For example:
- Pointing out flaws in the logic of arguments.
- Using logic to form and test inferences from data.

2.2 Respecting others and the environment in pursuing study of the natural world.

2.21 Valuing the use of investigative procedures that limit the risk to one's self, others, or the living and nonliving environment. For example:
- Taking safety precautions during investigations.
- Not injuring plants or animals without justifiable reason.
- Not disfiguring the environment while studying it.

2.22 Respecting the rights of others in using resources. For example:
- Using no more than one's share of common resources.
- Leaving work areas neat for the next user.

1.3 Wanting to know about and understand the natural world.
- 1.31 Wanting to know concepts, terms, techniques, and conventions useful in understanding the natural world. For example:
  - Asking about the meaning of terms.
  - Trying to identify specimens.
  - Trying to learn how to use measuring instruments.
- 1.32 Wanting accurate and thorough information about the natural world. For example:
  - Asking for and looking up factual information.
  - Making and studying specimen collections.
- 1.33 Wanting explanations and interpretations of information that clarify and lead to accurate predictions. For example:
  - Asking for explanations.
  - Questioning explanations.

2.23 Valuing the contribution of a fair share of the effort in carrying out collaborative studies. For example:
- Doing one's share of the work in a group project.
- Contributing ideas in group problem solving.
- Providing assistance to others in the group when appropriate.

2.24 Respecting the contributions of others to the solution of a problem. For example:
- Giving credit to others when using their ideas.
- Listening to the ideas of others in solving problems.
- Accepting the ideas and efforts of a handicapped person in group problem solving.
- Finding ways to utilize a handicapped person's unique talents in group problem solving.

2.25 Valuing truthful reporting of methods and findings. For example:
- Accurately describing procedures used in gathering data.
- Describing honestly the results obtained from an experiment.

2.26 Respecting the beliefs and values of others in presenting one's own ideas or findings. For example:
- Not ridiculing the ideas of others while presenting one's own ideas.
- Not making remarks which show insensitivity to the beliefs and values of others.

B. VALUING THE USE OF WHAT IS KNOWN ABOUT THE NATURAL WORLD FOR THE BENEFIT OF PRESENT AND FUTURE GENERATIONS.

1. Valuing the practical and technological.

1.1 Enjoying working with living and nonliving materials and with scientific techniques or having a high regard for those who do. For example:
- Choosing to work with material things when options are available.
- Caring for plants and animals as a hobby.
- Choosing to construct or take apart mechanical devices.
- Expressing interest in technological occupations.

1.2 Valuing resourcefulness and innovativeness in the solution of practical problems. For example:
- Attempting to use materials in novel ways to solve problems.
- Complimenting others for expressing innovative ideas.

1.3 Caring about efficiency, simplicity, and dependability of techniques. For example:
- Continually trying to improve techniques by increasing efficiency, simplicity, or dependability.
- Commenting on the efficiency, simplicity, or dependability of techniques or devices.

2. Valuing service to others through technology.

2.1 Caring about the needs and problems of others. For example:
- Expressing concern for the well-being of others.
- Attempting to find out more about a problem that others may have.

2.2 Valuing the benefits that technological change may have on people and the environment. For example:
- Following technological progress in a field through reading or other media.
- Expressing ideas about potential technological advances that might benefit people or the environment.
- Expressing ideas on how technology can assist handicapped individuals in accomplishing the same tasks as nonhandicapped peers.

2.3 Having concern for the potential adverse consequences of technological change on present and future generations and on the environment. For example:
- Questioning the value of certain technological changes.
- Studying and sharing the problems and dangers that a particular technological change may have on people and the environment.

SCIENCE CONTENT

...an effective problem solver must be knowledgeable...

PROGRAM GOAL: Students will increase their understanding of science principles.

A principle of science is a statement about objects or events occurring in nature. It describes a fundamental "truth" about nature as it is understood and generally accepted, based on scientific investigation. The statement organizes knowledge by relating concepts. The statement also describes the "truth" independent of imposed classifications or designations. For example, the statement, "Objects have properties determined by the forms, amounts, and properties of the materials of which they are made," is a principle. It is based on fundamental "truths" of nature revealed to us through our investigations. Examples of objects that illustrate this principle include rocks, clouds, leaves, ice cubes, and magnets. On the other hand, the statement, "Rocks are grouped as igneous, sedimentary, and metamorphic" is not a principle. It is based on an imposed label and grouping of objects. The former statement appears in this syllabus as a principle. The latter statement would not appear among the principles in this syllabus but might be an outcome of an activity in which objects (rocks) are grouped (classified) according to some observed properties into categories (igneous, sedimentary, and metamorphic).

The principles in the Science Content component are organized in a general scope and sequence scheme shown in the figure at the right. The organization is based on the following assumptions:

- —To understand the more encompassing principles, students must first understand the underlying specific principles.
- —Students will use understandings gained in one level as a foundation for the next level.
- —Principles organized in a parallel form, for example those relating to plants and animals, and objects and events (see Level I), become the foundation for developing an understanding of higher order integrating principles. Examples of these include principles relating to dependency and interaction (see Level I).
- —The relationships between life science and physical science are developed through principles dealing with ecosystems.

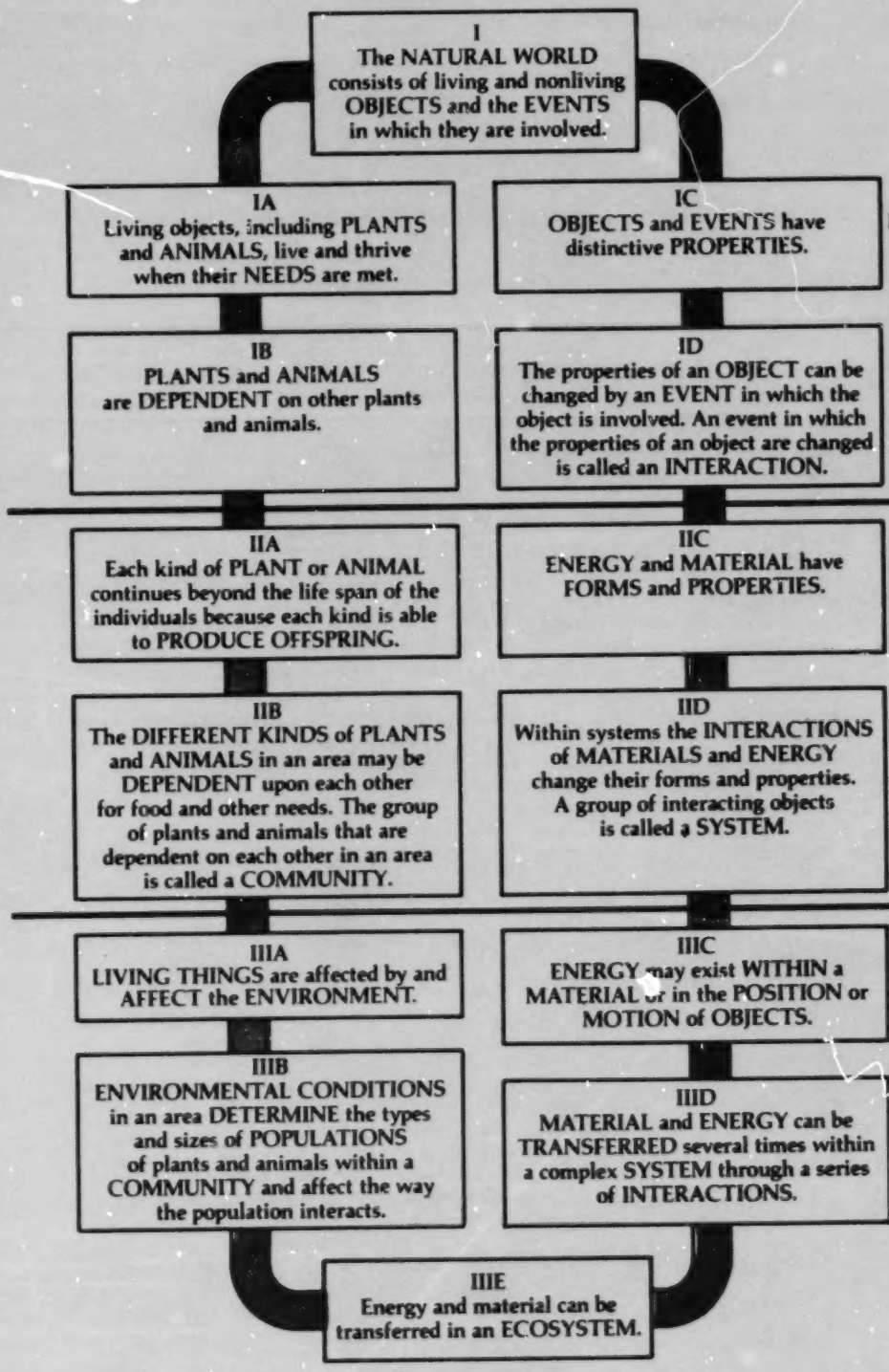
Please note, however, that the sequence of the content is implied only in terms of the three age-related levels. The syllabus does not provide specific sequences within a level or for individual grades. You must establish those sequences in your own local program.

The scope of the science content includes the major principles that you should include in your local program. Principles are not listed from some areas of subject matter such as atomic structure of matter and micro-structure of living things. First of all, those areas should be introduced at a later time when students are older and are better able to handle the abstractions that are involved. Secondly, it is difficult to provide hands-on experiences for students on those topics.

The principles have been organized into two broad categories: life science and physical science. As you develop students' understanding of the principles, consider using program activities from any topical areas that illustrate the principles, including biology, ecology, geology, meteorology, astronomy, oceanography, chemistry, and physics. The principles presented in the syllabus pervade all those areas of study.

Elmira City School District

Children enter school with some perception of the natural world with its living and nonliving objects and the things that happen to them. Elementary science education enables the children to build upon and expand their perceptions. The statement, "The natural world consists of living and nonliving objects and the events in which they are involved," is both the beginning of and the foundation for the entire science content scheme.


I
The NATURAL WORLD consists of living and nonliving OBJECTS and the EVENTS in which they are involved.
IA
Living objects, including PLANTS and ANIMALS, live and thrive when their NEEDS are met.
IB
PLANTS and ANIMALS are DEPENDENT on other plants and animals.
IC
OBJECTS and EVENTS have distinctive PROPERTIES.
ID
The properties of an OBJECT can be changed by an EVENT in which the object is involved. An event in which the properties of an object are changed is called an INTERACTION.
IIA
Each kind of PLANT or ANIMAL continues beyond the life span of the individuals because each kind is able to PRODUCE OFFSPRING.
IIB
The DIFFERENT KINDS of PLANTS and ANIMALS in an area may be DEPENDENT upon each other for food and other needs. The group of plants and animals that are dependent on each other in an area is called a COMMUNITY.
IIC
ENERGY and MATERIAL have FORMS and PROPERTIES.
IID
Within systems the INTERACTIONS of MATERIALS and ENERGY change their forms and properties. A group of interacting objects is called a SYSTEM.
IIIA
LIVING THINGS are affected by and AFFECT the ENVIRONMENT.
IIIB
ENVIRONMENTAL CONDITIONS in an area DETERMINE the types and sizes of POPULATIONS of plants and animals within a COMMUNITY and affect the way the population interacts.
IIIC
ENERGY may exist WITHIN a MATERIAL or in the POSITION or MOTION of OBJECTS.
IIID
MATERIAL and ENERGY can be TRANSFERRED several times within a complex SYSTEM through a series of INTERACTIONS.
IIIE
Energy and material can be transferred in an ECOSYSTEM.

LEVEL I

Be sure that program activities involve: plants and animals that are familiar to students, easily maintained, and readily accessible; and objects and events, including interactions, that are familiar to students and readily accessible.

Ages 4 through 7 years

LEVEL II

Be sure that program activities involve: flowering plants and animals familiar to students, simple communities that are easily maintained and readily accessible; and properties and forms of materials and energy that can be experienced directly and systems that are familiar to students.

Ages 7 through 9 years

LEVEL III

Be sure that program activities include: green plant populations, animal populations and environmental conditions that illustrate interactions; conditions and/or complex systems that illustrate material and energy interactions, and interactions in ecosystems. All of these activities should be familiar to students and be readily accessible.

Ages 9 through 11 years

Students who complete Level III are ready to continue their program of study of the natural world, its objects and events, and to use their knowledge for effective problem solving.

LEVEL I — LIFE SCIENCE

IA. LIVING OBJECTS, INCLUDING PLANTS AND ANIMALS, LIVE AND THRIVE WHEN THEIR NEEDS ARE MET.

1. Each plant has properties that enable the plant to meet its needs.

1.1 The parts of plants have functions that help the plant to live and thrive.
- 1.11 Roots help plants take in water.
- 1.12 Leaves help plants utilize sunlight.
- 1.13 Stems, stalks, trunks, and other similar structures provide support for the plant.

1.2 Parts of some plants change and meet the immediate needs of the plant. For example:
- Leaves turn toward light, and some close in the dark.
- Some roots grow more rapidly in moist areas.

1.3 The parts of some plants undergo seasonal changes that enable the plant to grow. For example:
- Seeds germinate.
- Leaves form and grow.
- Some roots and tubers store food.

1.4 Each kind of plant goes through its own stages of growth and development during the life span of the plant. The length of time from beginning of development to death of the plant is called its *life span*.
- 1.41 Stages of development in some plants include seed, seedling, and mature plant.
- 1.42 Stages of development in some plants include bulb, young plant, and mature plant.

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2. Each animal, including humans, has properties that enable the animal to meet its needs.

2.1 The parts of animals have functions that help the animal to live and thrive.
- 2.11 Wings, legs, or fins enable some animals to seek shelter and to escape predators.
- 2.12 The mouth, including teeth, jaws, and tongue, enables some animals to eat and drink.
- 2.13 The nostril enables some animals to acquire air.
- 2.14 Eyes, nose, ears, tongue, and skin of some animals enable the animals to sense their surroundings.
- 2.15 Claws, shells, color of body covering, and other structures enable some animals to protect themselves from other animals.
- 2.16 Feathers, fur, and scales enable some animals to protect themselves from the surrounding conditions.
- 2.17 Some animals have parts that are used to produce sounds to help the animal meet its needs.

2.2 The parts of some animals change and meet the immediate needs of the animal. For example:
- Skin — perspiration rate changes to regulate temperature.
- Heart — rate of beating changes during emergencies.
- Eyelids — blinking or closing helps protect the eyes.
- Lungs — breathing rate changes to provide varying amounts of air.

2.3 The parts of some animals change as seasonal conditions change and that helps the animal to meet its needs. For example:
- Fur grows and is shed to help regulate body heat.
- Body fat as a form of stored food changes as the season changes.

2.4 Each kind of animal goes through its own stages of growth and development during the life span of the animal. The length of time from birth to death of the animal is called its *life span*.
- 2.41 Animals go through a particular set of stages from young to adult. Examples include:
  - Many insects go from egg to larva to pupa to adult.
  - Frogs go from egg to tadpole to adult.
  - Larger animals change gradually in size from young to adult.
- 2.42 Animals have life spans of varied length. For example:
  - A mealworm has a shorter life span than a dog.
  - One mealworm's life span may be longer than another's.

	IB. PLANTS AND ANIMALS ARE DEPENDENT ON OTHER PLANTS AND ANIMALS.
1.43 Plants have life spans of varied length. For example: • A bean plant has a shorter life span than a tree. • One bean plant may have a longer life span than another bean plant. 1.5 The properties of plants and their parts vary from one kind to another and from one individual to another. For example: • Maple trees and pine trees differ in appearance. • Leaves on a maple tree vary in size from one leaf to another.	**1. Animals depend on plants. For example, as:** • A source of food • Material for shelter • Shade from the hot sun • Material to make cloth • Material to make dyes • Material for medicine • Adornment for beauty • Protection of soil against erosion • Fuel **2. Plants benefit from animals. For example:** • Seeds are dispersed by some animals. • The actions of some animals affect the numbers of other animals that are plant eaters. • Earthworms aerate the soil. **3. Animals depend upon other animals. For example:** • Some animals eat other animals for food. • Humans make clothing from parts of some animals. • Humans make pets of some animals for enjoyment, protection, and assistance in compensating for disabilities. • Humans use some animals to perform work and to provide humans with recreation.
2.5 Animals, including humans, are able to control some conditions around them and meet their needs For example: • Some animals, including humans, make shelters to control temperature, light, and moisture conditions. • Some animals, including humans, store food and water to be available when needed. • Humans increase the amount of foodstuff produced by providing favorable conditions for its growth, that is, by farming. • Humans can compensate for difficulties or disabilities by controlling the environment. 2.6 Some animals, including humans, move from place to place and meet their needs. For example an animal may: • migrate with the seasons. • seek shade, food, or water. • seek escape from danger. 2.7 The properties of animals and their parts vary from one kind to another and from one individual to another. For example: • Birds and dogs differ in appearance. • Different kinds of dogs are different in size. • A given kind of dog varies in size from one individual to another.	

LEVEL I — PHYSICAL SCIENCE

IC. OBJECTS AND EVENTS HAVE DISTINCTIVE PROPERTIES.

1. The properties of an object are determined by its material and condition.

1.1 Some properties of an object are dependent upon the materials from which the object is made.

1.11 Different kinds of materials have different properties. For example:
- Weight
- Color
- Texture
- Hardness
- Brightness
- Reflectiveness (mirrors) to light, sound, and heat
- Transparency to light
- Sound — when struck, plucked, or vibrated

1.12 A kind of material may be divided into smaller parts or changed in shape without changing the properties of the materials. For example:
- Shaping clay
- Crushing stone
- Cutting wood

1.13 Under particular conditions most materials are solid, liquid, or gas. For example:
- Ice at temperatures below freezing
- Water at room temperature
- Steam at boiling point

1.14 An object composed of two or more different materials that have been mixed may have some properties like each of the original materials and some new properties. For example:
- Green water color — formed from mixture of yellow and blue water colors
- Sugar water — formed from sugar cube and water
- Whipped cream — formed from cream, sugar, vanilla, and air

1.2 Some properties of an object are determined by the place in space that it occupies. For example:
- Distance from other objects, such as between two desks, home and school, or parked cars
- Location in reference to other objects
- Position — upside down, right side up, backward, forward
- Direction — (in relation to another object) in front of, behind, above, below, inside, outside

2. The properties of an event are determined by objects, space, and time.

2.1 An event occurs at a particular moment in time and place in space. For example:
- When a person was born and the location
- When a person started to eat breakfast and the location
- What a person is doing at this instant and where
- When a person leaves the school on a particular day

2.2 An event can take time to occur. For example, the time required for:
- A candle to burn
- A sugar cube to dissolve in water
- A quantity of water to boil when heated
- A single swing of a pendulum such as a playground swing
- The sun to pass across the sky from the morning to the afternoon
- A seed to germinate

2.3 Events may occur in a particular sequence over time and in a particular order in space. For example:
- Morning to noon to night
- Rising sun to high noon to setting sun
- Wake up to breakfast to school
- Home to school
- Television program begins and ends
- Planting seeds to growing plant to harvesting crops
- Birth of an animal to growing up to dying
- Spring to summer to fall to winter
- A past event, a present event, a future event

2.4 Two events can mark the passage of time. For example, from:
- One tick of a clock to the next
- Going to school to returning home
- One birthday to the next.

ID. THE PROPERTIES OF AN OBJECT CAN BE CHANGED BY AN EVENT IN WHICH THE OBJECT IS INVOLVED. AN EVENT IN WHICH THE PROPERTIES OF AN OBJECT ARE CHANGED IS CALLED AN *INTERACTION*.

1.3 The space occupied by an object is determined by the properties of the object. For example:
- Size such as a grain of sand, a toy ball, or the school building
- Shape such as round (ball-like), flat, cube (box-like).

1.4 Two objects cannot occupy the same place at the same time.

1.5 Some properties of an object are dependent on the conditions of the present surroundings in which the object exists. For example:
- Temperature — hot or cold
- Lighting — shadows, brightness, color
- Moisture — wet or dry

1. Objects interact with heat.

1.1 Heating can make objects warmer. Removing heat can make objects cooler.

1.2 Adding heat to a material can form liquids or gases from solids and form gases from liquids. Examples include:
- Solids to liquids — melting chocolate or ice
- Solids to gases — mothballs or dry ice to vapor (gas)
- Liquids to gases — boiling water

1.3 Removing heat from a material can form liquids or solids from gases and form solids from liquids. Examples can include:
- Gases to solids — formation of frost or snow
- Gases to liquids — condensation of water droplets on a cold surface
- Liquids to solids — freezing water to form ice

1.4 Many materials change volume when heated or cooled.

2. An object can be pushed or pulled to cause the object to change its motion.

2.1 The change in motion of an object is in the direction of the push or pull exerted on the object.

2.2 The push or pull needed to cause a change in motion of an object depends upon the weight (massiveness) of the object. The heavier (more massive) the object, the larger the push or pull needed to produce the same change in motion.

2.3 The amount of change in motion of an object can be affected by the surface of the object and the surface of the material the object touches. The rougher the surface, the greater the push or pull needed to move the object.

2.5 Some types of events occur over and over again at regular intervals of time. For example:
- The ticking of a clock
- The turning of a phonograph record
- The swing of a pendulum such as a playground swing
- The showing of a particular television program
- The eating of a meal such as breakfast
- The rising or setting of the sun
- The direction of the sun-cast shadow of an object such as a tree or flagpole
- The beginning of summer vacation
- A person's birthday

2.6 Events involving motion of an object or its parts occur over a distance in space. For example:
- An object falls from a desk to the floor through a vertical distance
- An object moves over a horizontal distance such as a ball rolled across the floor
- A phonograph record turns
- A pendulum (playground swing) swings through a distance

3. Objects that are not falling are interacting with the object upon which they rest because they are being supported by it.

3.1 Objects on a uniform balance beam may or may not be in balance depending on the location of the support.

3.11 When two objects of equal weight are balanced (on a uniform balance beam) they are the same distance from the balance point.

3.12 When two objects of unequal weight are balanced (on a uniform balance beam) the lighter weight object is farther from the balance point than the heavier weight object.

3.2 Some objects fall through a liquid (sink) while others are supported by it (float). Floating or sinking depends upon properties of objects such as:
- The shape of the object
- The position of the object (face up or face down)
- The weight of the object
- The type of material in the object

LEVEL II — LIFE SCIENCE

IIA. EACH KIND OF PLANT OR ANIMAL CONTINUES BEYOND THE LIFE SPAN OF THE INDIVIDUALS BECAUSE EACH KIND IS ABLE TO PRODUCE OFFSPRING.

1. The flowers of flowering plants form enough seeds suited to survive to produce the next generation of that kind of plant.

1.1 Each generation of flowering plants goes through changes from seed to mature plant. The mature plant gives rise to the seeds of the next generation. This completed sequence of changes in form is called a *life cycle*.

1.2 The flower is the structure in mature flowering plants that enables offspring to be produced in the form of seeds.

1.21 The transfer of pollen is essential for seeds to form.

1.22 The transfer of pollen grains may be aided by outside factors. For example:
- Bees
- Hummingbirds
- Wind

1.23 Seeds are found in fruits. For example:
- Apples
- Peapods
- Watermelons
- Tomatoes
- Pumpkins

1.3 Seeds have properties that enable them to survive and develop into new plants.

1.31 Seeds have properties that aid in their dispersal. For example:
- Wings enable wind dispersal
- Light weight enables water dispersal and air dispersal
- Burrs enable dispersal by animals
- Hard seedcoat enables dispersal when eaten by animals

1.32 Some seeds may be able to withstand severe conditions including cold winters and drought.

1.33 Seeds will germinate and produce seedlings under particular conditions of temperature and moisture.

1.34 Seeds contain stored food that aids in germination and the growth of seedlings.

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2. Adult animals are able to produce enough young suited to survive to produce the next generation of that kind of animal.

2.1 Each generation of animals goes through changes in form from young to adult. The adult gives rise to the young of the next generation. This completed sequence of changes in form is called a *life cycle*.

2.2 For some types of animals, the young of the new generation are better able to live and thrive because certain kinds of care are provided to them by the adults of the previous generation. Examples include:
- Shelter in the form of nests or homes
- Protection from other animals that are dangerous
- Food
- Warmth
- Education (humans) — training (monkeys)

2.3 Some types of young animals are able to live and thrive without depending on adults of the previous generation for care. For example:
- Frogs
- Mealworms
- Fish
- Butterflies

2.4 Animals have the potential to produce numerous offspring during their adult stage.

2.41 Under actual conditions, not all of the young produced grow and become adults. The number of animals of a particular kind living in an area is called the *population*.

1.4 Structures other than flowers enable offspring to be produced in some plants. For example:
- Runners
- Tubers
- Bulbs
- Leaf and stem cuttings

1.5 Plants have the potential to produce numerous offspring.

1.51 Each flowering plant may have several flowers and each flower may be capable of producing many seeds.

1.52 Under actual conditions only a small number of the seeds produced by flowering plants grow and become adult plants. The number of plants of a particular kind growing in an area is called the *population*.

IIB. THE DIFFERENT KINDS OF PLANTS AND ANIMALS IN AN AREA MAY BE DEPENDENT UPON EACH OTHER FOR FOOD AND OTHER NEEDS. THE GROUP OF PLANTS AND ANIMALS THAT ARE DEPENDENT ON EACH OTHER IN AN AREA IS CALLED A *COMMUNITY*.

1. The plants in a given area provide the basic food supply for animals because only plants can manufacture food by utilizing the sun's energy.

1.1 Animals that eat plants for food may in turn become food for other animals. This sequence is called a *food chain*.

1.2 Dependencies among plants and animals can be complex. A particular plant or animal may be eaten by different types of animals, each of which in turn may be eaten by more than one type of animal. This complex network of two or more food chains is called a *food web*.

2. The size of the population of individual kinds of plants or animals in an area is affected by the dependencies of animals on plants and other animals for food (other factors being equal).

2.1 As the food supply of some animal populations changes, the animal populations will tend to change. For example:
- If the rabbit and mouse populations in a given area increase, the hawk population tends to increase.
- If the algae populations in a pond increase, the fish populations tend to increase.

2.2 As the population of some animals changes, the food supply of that animal population will tend to change. For example:
- If the deer population in a given area increases, populations of browse, such as small trees and shrubs, tend to decrease.
- If the fox population in a given area increases, the pheasant and rabbit populations tend to decrease.

LEVEL II — PHYSICAL SCIENCE

IIC. ENERGY AND MATERIAL HAVE FORMS AND PROPERTIES.

1. Objects have properties determined by the forms, amounts, and properties of the materials of which they are made.

1.1 Some properties of an object are determined by the form of the material of which it is composed.

1.11 Properties of an object can be affected by the shape of the material. For example:
- Buoyancy of aluminum foil shaped like a boat
- Structural strength — flexibility of pleated aluminum foil
- Rate of evaporation of a liquid spread over a large area
- Rate at which a solid moves through air or water — lump of clay shaped as a ball, cylinder, or disc

1.12 Properties of an object can be affected by the phase of the material (solid, liquid, or gas). For example:
- Fluidity of water compared with ice
- Visibility of water vapor compared to liquid water
- Hardness of ice compared to water
- Compactness of water vapor compared to liquid water
- Containability of ice compared to liquid water

1.13 Properties of an object can be affected by the size of solid particles contained within the material. For example:
- Transparency of a liquid affected by suspension of solids in the liquid
- The ability of sand to flow as compared to gravel
- Texture or feel of sandstone rock compared to shale rock
- Compactness of a material containing uniformly sized particles compared to a mixture of mixed sizes of particles

2. Energy can vary in form, amount, and ability to move through materials and space.

2.1 Energy can exist in several forms. For example:
- Mechanical
- Heat
- Electrical
- Magnetic
- Sound
- Light
- Chemical

2.2 Energy can move from one object to another, through materials and through space. For example:
- Mechanical energy is transferred from one point in space to another point through the application of force and moving objects, such as gears, pulleys, and levers.
- Heat moves through some materials more easily than others, such as metal compared to wood.
- Electricity moves more easily through some materials such as metal conductors and does not move easily through materials such as rubber and glass which are insulators. Electricity can move through some liquids.
- Magnetism can pass through space and through certain materials more easily than others, such as paper compared to iron.
- Light moves in a straight path through space and through some material more easily than others, such as glass compared to paper.
- Sound moves in all directions through air and through some kinds of material more easily than others, such as a string-can telephone compared to air.

1.2 Some properties of an object may be determined by the amount of material in the object. For example:
- Volume
- Weight
- Amount of water a floating object will displace
- The forces needed to change the motion of the object (start or stop it; speed or slow it)

2.3 The amount of energy available from a source can vary. For example:
- The amount of mechanical energy applied by a person to a weight will affect how high the weight can be lifted.
- The amount of heat energy from a burning candle will affect the amount it is able to raise the temperature of a given quantity of water.
- The amount of electrical energy in a particular battery affects the length of time a light bulb can be lighted.
- The amount of magnetic energy available in a magnet affects how many objects, such as paper clips, can be lifted.
- The amount of light energy coming from a light bulb determines the brightness of light on an area.
- The amount of energy present in a source of sound affects its loudness.
- The amount of chemical energy present in a fuel affects the amount of heat it gives off when burned.

IID. WITHIN SYSTEMS THE INTERACTIONS OF MATERIALS AND ENERGY CHANGE THEIR FORMS AND PROPERTIES. A GROUP OF INTERACTING OBJECTS IS CALLED A *SYSTEM*.

1. Energy can be changed in form by interactions with materials. Examples can include:

Form of Energy	Is Changed by a System such as a	To New Form of Energy
• Mechanical	— bicycle generator	electricity
	— bicycle brakes	heat
	— drum, violin, horn, piano	sound
• Heat	— gasoline engine	mechanical
	— tea kettle	sound
	— flame	light
	— incandescent light bulb	light
• Electrical	— food blender motor	mechanical
	— electromagnet	magnetic
	— electric coil	heat
	— radio speaker	sound
	— bulb filament	light
• Magnetic	— magnetic door latch	mechanical
	— radio speaker	sound
• Light	— solar cell	electricity
	— green leaf	chemical
	— camera and film	chemical
• Sound	— microphone	electricity
• Chemical	— battery and circuit	electricity
	— oil heating system	heat
	— gasoline engine	mechanical

2. Energy in a particular form can be transferred from one object to another in a system. For example:
- Mechanical energy exerted by one object can push or pull another.
- Heat can be transferred from one object to another.
- Magnetism can be caused in some kinds of materials by a magnet.
- Light can be reflected from one object to another.
- Sound can be reflected from an object causing an echo.

3. When energy interacts with objects in a system the properties of the objects may be changed. For example:
- The shape of objects can be changed by forces such as shaping clay by hands.
- Forces may break up or compact objects such as breaking up ice cubes with a hammer or the wearing away of colliding rocks in moving water.
- The heating of an object such as water (ice) can change the water's phase from solid to liquid to gas.
- Electricity flowing in a wire may cause the wire to become warm and glow such as in a clear incandescent light bulb.
- Plating of metals on the surfaces of conducting materials can be caused by electricity, such as copper plating on carbon rods.
- Chemical reactions such as a burning candle, vinegar and baking soda, or boiling an egg, change properties of materials.

LEVEL III — LIFE SCIENCE

IIIA. LIVING THINGS ARE AFFECTED BY AND AFFECT THE ENVIRONMENT.

1. The life of a plant is affected by environmental conditions.

1.1 Plant health, growth, and development are affected by environmental conditions, such as:
- Water
- Temperature
- Sunlight
- Soil nutrients
- Space available
- Atmosphere

1.2 Plants may change when environmental conditions change, helping the plants to live.

1.21 Plant structures move when influenced by changing environmental conditions. For example:
- The leaves of some green plants change position as the direction of light changes.
- The growth rate of roots of some green plants changes as available moisture changes.

1.22 The formation of particular plant structures is influenced by changing conditions of light, moisture, and temperature. For example:
- Flowers form
- Leaves form
- Spores form

2. The life of an animal is affected by environmental conditions.

2.1 Animal health, growth, and development are affected by environmental conditions, such as:
- Food available
- Air available
- Water available
- Space available
- Shelter available
- Temperature
- Sunlight

2.2 The behavior of animals may change when environmental conditions change.

2.21 Animals move to find optimal environmental conditions within an area. For example they may:
- move to shade from the hot sun
- run from danger

2.22 The formation of particular animal characteristics is influenced by changing environmental conditions. For example:
- Fat storage in winter
- Coat thickness in winter
- Coat color protection
- Shedding of fur

2.23 Animals carry out certain routine behaviors that are influenced by environmental conditions. For example:
- Nest building to provide shelter
- Sleeping daily and hibernating
- Hunting
- Migrating

IIIB. ENVIRONMENTAL CONDITIONS IN AN AREA DETERMINE THE TYPES AND SIZES OF POPULATIONS OF PLANTS AND ANIMALS WITHIN A COMMUNITY AND AFFECT THE WAY THE POPULATIONS INTERACT.

1.3 The life of a green plant is affected by the amount of light energy available from the environment.
- 1.31 The leaves of green plants absorb light energy from the environment and transform it into forms which can be used and stored.
- 1.32 Absorbed and stored energy is used for growth and development of a plant and the production of its offspring.
- 1.33 Green plants store energy in the form of food substances. The stored food is used as a source of energy by the germinating seed. The growing plant can use the stored food as a source of energy during periods when enough energy cannot be absorbed from the environment for food production.

1.4 Plants may affect the environment. For example:
- Some plants create humus.
- Some plants create shade.
- Some plants change soil structure.
- Some plants add oxygen to the air.

2.3 Animals obtain energy in various forms from the environment.
- 2.31 Animals, including humans, obtain energy that has been stored in food.
- 2.32 Animals, including humans, obtain heat energy from the sun.
- 2.33 Humans utilize energy for heat that has been stored in fuels.

2.4 Animal behavior may affect the environment. For example:
- Depositing of waste materials
- Consumption of food such as prey
- Building structures such as shelters
- Destruction of vegetation
- Damming of water
- Adding carbon dioxide to the air

1. Different kinds of plant and animal populations exist in various environments. Examples include:
- Aquatic — seaweed, fish
- Desert — cactus, lizards
- Tropical — palm trees, boa constrictors
- Mountains — pine trees, eagles

2. Changes in local environmental conditions may bring about changes in various population sizes within a community in an area.

2.1 Environmental conditions may directly affect population sizes within the community. For example:
- Fire or floods may kill plants and animals.
- A late spring freeze may destroy blossoms and reduce seed production of plants.

2.2 Environmental conditions may affect one part of a food chain and thereby affect other parts. For example:
- A mild winter may bring about an increase in the gypsy moth population, which eventually may reduce the oak tree population.
- A forest fire may reduce the plant material available for grazing, which in turn may cause a reduction in the deer population in an area.
- Acid rain may kill plants that animals depend upon for food.
- A severe drought may kill plants that animals depend upon for food.

New York Energy Education Project

LEVEL III — PHYSICAL SCIENCE

IIIC. ENERGY MAY EXIST WITHIN A MATERIAL OR IN THE POSITION OR MOTION OF OBJECTS.

1. Energy within the materials of objects may be transferred through them.

1.1 Electrical energy can flow through circuits.

1.11 Electrical energy results from positive and negative charges in which like charges repel and opposite charges attract.

1.12 Electrical energy can be stored in batteries.

1.13 A complete circuit will enable electrical energy to flow from a battery through a conductor.

1.14 The amount of energy transferred during a flow of electrical energy depends on the source and properties of the object to which it is applied.

1.15 Electrical energy flowing in a wire produces a magnetic field around the wire.

1.16 A magnet moving within a coil of wire will produce a flow of electrical energy in the wire.

1.2 The interaction of materials may produce new materials and energy may be absorbed or given off.

1.21 New materials produced by interactions have properties that are different from the old materials. For example:

- Carbon and water vapor produced by a burning candle collected on a cold surface
- Gas produced by vinegar and baking soda interaction

1.22 Some interactions that give off energy may require some energy to start the interaction; others start with no energy being added. For example:

- Lighting a candle requires energy to be added.
- Aluminum mixed with copper sulfate solution requires no energy to be added.

1.23 Energy may be given off when new materials are being produced. Examples can include:

Energy	Interaction
• Heat	— Calcium oxide mixed with water — Aluminum mixed with copper sulfate solution
• Electrical	— Aluminum strip and carbon rod in copper sulfate solution. — Discharging a flashlight battery
• Light	— Burning candle

2. Energy can be transferred by changing the position of objects.

2.1 Work must be done on an object in order to transfer energy to the object.

2.11 The higher an object is lifted the more work must be done on the object and the greater the amount of energy transferred to it.

2.12 The greater the increase in the motion of an object the greater the amount of work that has been done on the object, and the greater the transfer of energy to it.

2.2 The amount of work done on an object depends upon the size of the force and the distance through which the force is applied to the object.

2.21 A simple machine such as an inclined plane or a lever can be used to change the direction and size of a force.

2.22 Simple machines change the distance through which the force acts.

2.23 An inclined plane or lever can be used to move a heavy object a small distance using a small force; or using a larger force, lift a lighter object a larger distance.

1.24 Energy may be absorbed from the surroundings when new materials are being produced. For example:

Energy	Interaction
• Heat	— Combining ammonium chloride with water — Darkening of thermal sensitive copy paper
• Electrical	— Electroplating of copper — Electrolysis of water — Charging a storage battery
• Light	— Silver nitrate and sodium chloride — Photographic film — Photosynthesis in plants

1.3 Heat flows spontaneously from warmer objects to colder ones.
- 1.31 Larger amounts of the same material absorb or lose larger amounts of heat energy for a particular temperature change.
- 1.32 Different types of material absorb or lose different amounts of heat energy for a particular temperature change.
- 1.33 The flow of heat energy between two objects is greater when their temperature differences are greater.
- 1.34 The flow of material can transfer heat from one location to another. For example:
  - Flowing lava
  - Moving water
  - Air currents

2.3 Many man-made devices (tools or machines) are made of levers or inclined planes in combination, which can be used to transfer energy. For example:
- Wheels
- Pulleys
- Gears
- Wheelchair
- Bicycle
- Screwdriver
- Rail
- Jackhammer

2.4 Forces are exerted by liquids and gases.
- 2.41 A liquid or gas in a closed container exerts force on the walls of the container.
- 2.42 A force applied over a large area exerts less pressure than the same force applied to a small area.
- 2.43 The pressure within a fluid is greater at greater depths.

IIID. MATERIAL AND ENERGY CAN BE TRANSFERRED SEVERAL TIMES WITHIN A COMPLEX SYSTEM THROUGH A SERIES OF INTERACTIONS.

1. **Material and energy may be changed in form more than once as interactions occur within a complex system. For example:**
   - The automobile — the chemical energy of the fuel is transformed to heat energy and then to mechanical and electrical energy. The material of the fuel which has lost its usable energy is given off as liquid and gas waste.
   - The electrical energy generating plant — at the coal-burning generator, the energy of the fuel is transformed to heat energy and then to electricity to be transmitted for use. The material in the fuel which has lost its usable energy is given off as solid, liquid, and gas waste.
   - The teletypewriter transforms auditory signals into visual symbols.
2. **Material and energy may be transferred from one location to another in a complex system. For example:**
   - The home heating system — heat can be distributed around a house by water in pipes, air in ducts, or radiated from sources through space.
   - The community electrical energy system — electricity produced at a generating plant is distributed through wires to houses and within houses to locations where it is used.
3. **The total material and energy within a system may decrease as some is lost to the surroundings. Some systems lose material or energy faster than others. For example:**
   - The home heating system — heat is lost to the outside during cold weather and the material of the fuel which has lost its usable energy is given off as liquid, solid, and gas waste.
   - The automobile — heat is lost from the surface of the engine, friction of moving parts and loss of hot gases.
4. **Material and/or energy must be added to a complex system to maintain the interactions. For example:**
   - Home heat — fuel is added
   - Automobile — fuel is added
   - Bicycle — fuel in the form of food is needed for the operator
   - Water cycle — solar energy is needed
   - Mountain building — heat from within the earth creates volcanoes and earthquakes which move rock materials.

LEVEL III — ECOSYSTEMS

IIIE. ENERGY AND MATERIAL CAN BE TRANSFERRED IN A SYSTEM CONSISTING OF LIVING AND NONLIVING OBJECTS THROUGH A SERIES OF INTERACTIONS. A SYSTEM CONSISTING OF A LIVING COMMUNITY THAT INTERACTS WITH ITS PHYSICAL ENVIRONMENT IS CALLED AN *ECOSYSTEM*.

1. Certain materials in an ecosystem (including minerals, water, and gases) are recycled over and over again, being transferred from the physical environment to the living community and back to the physical environment.

1.1 Materials from the physical environment are used by green plants to produce new plant material. Some of the new plant material is returned again to the environment as gas and water.

1.2 Animals take in materials from the living community and from the physical environment. These materials include gases, water, minerals, and food.

1.3 Materials taken in by animals either become part of the animal's material or are returned by the living animal to the physical environment again as waste material.

1.4 When a plant or animal dies and decays, the material of the plant or animal is returned to the physical environment again, such as to the soil.

2. Energy enters the ecosystem, changes the physical environment, and is used for growth and activity by its living community and eventually leaves the ecosystem.

2.1 Energy entering the ecosystem interacts with and changes the physical environment.

2.11 Environmental conditions are influenced by energy absorbed at any given location and time through interactions with water, air, and the surface. For example:

- Temperature
- Humidity
- Air pressure
- Wind speed and direction
- Lightning
- Cloud cover
- Surface moisture
- Water surface conditions — waves
- Precipitation
- Snow cover

2.12 Energy interacting with surface water can cause clouds to form. The energy is transferred as rain falls to the earth and flows to the oceans doing work on the surface of the earth in the form of erosion.

2.13 Energy absorbed by the atmosphere helps cause warmer air to rise. The energy is eventually transferred when moving air does work on the surface of the earth causing movement such as waves on the ocean, waving trees, or blowing sand.

2.2 Energy entering the ecosystem interacts with and changes the living community. Most of the energy entering the natural ecosystem comes from the sun.

2.21 Solar energy is absorbed by the material of green plants in the living community and is changed to chemical energy. This energy is used for immediate growth or is stored for later use by the living plants or their seeds.

2.22 Energy from plants is transferred to animals when animals eat the plants. This chemical energy is used for the immediate growth and activity of the animal or is stored.

2.23 When plants and animals die and decay some energy stored in the material of the plants and animals is released as heat energy and is transferred to the surroundings of the ecosystem.

3. Changes in one part of the ecosystem may affect other parts of the ecosystem. For example:

- Pollution
- Drought
- Flood
- Severe winters
- Changes in food supply
- Disease
- Migration
- Building cities
- Automobiles
- Roads
- Extinction of forms of life

PART III

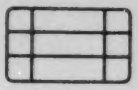
Schenectady Community Headstart Program

PROGRAM ACTIVITIES

. . . effective program activities use a problem solving approach. . .

	UNITS
	MINI UNITS
	UNIT STARTERS

GUIDELINES FOR PROGRAM ACTIVITIES



...effective program activities use a problem-solving approach...

PROGRAM CRITERION: Program activities will use a problem-solving approach.

PROGRAM ACTIVITIES are the teacher-planned activities you use with your students to teach them elementary science. These activities can cause students to encounter discrepancies.

The program activities in this publication are organized into units, mini-units, and unit starters. You may use them for example:

- directly as part of your local elementary science program, or
- as supplements to a commercial program.

UNITS focus on a central problem or theme. They require from several days to several weeks to complete. Units contain the greatest amount of lesson plan detail and supplementary information. You can use the format for units as a standard to help you develop your own units from other activities.

MINI-UNITS also focus on a central problem or theme. However, compared with units, they usually require less time to complete (from a few days to a few weeks) and contain less supplementary information and lesson plan detail. The lesson plans are sufficient to give you direction and assistance, but you should expand them into units and fit them to your personal style and the needs of students before you use them.

UNIT STARTERS focus on a problem or question. Use them to stimulate ideas that lead students to a deeper investigation into a problem. Unit starters contain the least amount of lesson plan detail. You may want to develop detailed lesson plans yourself or use the unit starters to help your students construct a complete plan for solving a problem.

Because unit starters can take a wide variety of forms, they could require from a day to several weeks to complete.

You can refer to the loose-leaf supplement of program activities for your level for more detailed information. The elementary science supplement is available from the State Education Department upon request

New York Energy Education Project

CORRELATING SYLLABUS AND PROGRAM

...appropriate problem-solving activities always correlate directly to the syllabus.

PROGRAM CRITERION: Program activities should always correlate directly to the skills, science attitudes, and science content defined in the syllabus.

The syllabus tells you what the State expects you to teach in elementary science. The Syllabus-Program Correlation Chart shows you which program activities you can use to teach a particular part of the syllabus.

An activity correlates to the syllabus if its expected outcome is the same as a desired outcome defined in the syllabus. Thus, in the illustration below, the program activity on "trees" correlates to the skill of "questioning," the science attitude of "respect," and the science content of "seed dispersal."

You can use the Syllabus-Program Correlation Chart both with program activities you design yourself and those you take from other sources. Once you have filled in the chart, you can use it to:

- provide a quick inventory of all program activities available,
- select appropriate program activities that will achieve specific syllabus outcomes, and
- determine which outcomes each program activity is expected to achieve.

You can also use the Syllabus-Program Correlation Chart:

- as a worksheet to determine the correlation to the syllabus of other instructional materials such as kits, field trips, media materials, trade books, and texts
- as an organizing sheet to help you develop a local sequence of instruction for each grade or each special grouping of students
- as an analysis sheet to help you answer such questions as:
  - — Are we teaching everything we should be teaching?
  - — Are we needlessly duplicating instruction between grades or levels?
  - — Are we providing enough reinforcement of outcomes within a grade or within a level?

SYLLABUS		ACTIVITY	BUOYANCY	TREES	CLOUDS	STREAM FIELD TRIP	MOVIE: MAPLE TREES	TEXT: CHAPTER 3				
SKILLS	CLASSIFYING				■							
	MEASURING					■						
	QUESTIONING	■	■	■				■				
	COMMUNICATING				■		■					
SCIENCE ATTITUDES	RESPECT			■			■	■				
	SAFETY					■						
	TRUTHFUL REPORTING	■										
	SERVICE							■				
SCIENCE CONTENT	MATERIAL SHAPE	■										
	ENERGY FORM			■	■							
	SEED DISPERSAL		■					■				
	STORED FOOD					■						

Extra blank correlation charts are included in Appendix G. Wall chart size versions of the charts are also available from the State Education Department upon request.

Schenectady Community Headstart Program

Schenectady Community Headstart Program

PART IV

APPENDICES

APPENDIX A

STATEMENT OF REGENTS GOALS FOR ELEMENTARY AND SECONDARY SCHOOL STUDENTS — 1984

The Regents Statement of Goals for students includes skills and characteristics that each student should acquire through education. Responsibility for education is shared by the family, schools, and other organizations in each community. The Regents goals can be realized only through a concerted effort by all of them. *The Regents Action Plan to Improve Elementary and Secondary Education Results in New York State* focuses on the actions schools can and must take to help students meet these goals.

Our Action Plan is directed toward what we want our children to be, to know and to be able to do. Our expectations and standards set for them reflect our anticipation of the knowledge, skill and capacity they must have to meet ever more rigorous challenges for employment and economic competition; for carrying their obligations in the governance of our democratic republic; for meeting their responsibilities to family, self and community; and for the perpetuation of our culture and civilization.

Our goals, expectations and aspirations for our children are the same for all. However, all children are not the same. They have different talents and abilities, interests and emotions, strengths and weaknesses. For each individual we desire an educational system that will both stimulate and urge the full development of potential. We must, therefore, provide considerable choice and flexibility for each student together with basic requirements. We want each child to develop self-confidence and a belief in the success in learning. We want each to develop a capacity for continued self-learning. We want each to develop self-discipline and a sense of decency and responsibility.

In order to put those objectives for self-development in the perspective of what is necessary for the individual to contribute to and succeed in society, we have the more general standards and credentials for all. These provide the societal guideposts and an indication of what each child and that child's own school need in preparation for taking part in a broader community.

The specific statements of goals that follow are all in terms of our expectations for students. They start with a first priority on language — the capacity to communicate which underpins all the rest of learning. These statements of goals are, in turn, translated in this Plan to courses, subjects, disciplines, and methods of inquiry for examining the world. Taken together the goals represent our judgments or choices for the meaning of a total elementary and secondary education.

***1. Each student will master communication and computation skills as a foundation to:**
- **1.1 Think logically and creatively.**
- **1.2 Apply reasoning skills to issues and problems.**
- **1.3 Comprehend written, spoken and visual presentations in various media.**
- 1.4 Speak, listen to, read and write clearly and effectively in English.
- **1.5 Perform basic mathematical calculations.**
- **1.6 Speak, listen to, read and write at least one language other than English.**
- **1.7 Use current and developing technologies for academic and occupational pursuits.**
- **1.8 Determine what information is needed for particular purposes and be able to acquire, organize and use that information for those purposes.**

2. Each student will learn methods of inquiry and knowledge gained through the following disciplines and use the methods and knowledge in interdisciplinary applications.
- 2.1 English language and literature.
- 2.2 History and social sciences.
- **2.3 Mathematics.**
- **2.4 Natural sciences.**
- 2.5 Language and literature in at least one language other than English.

3. Each student will acquire knowledge, understanding, and appreciation of the artistic, cultural, and intellectual accomplishments of civilization and will develop the skills to express personal artistic talents. Areas include:
- 3.1 Ways to develop knowledge and appreciation of the arts.
- 3.2 Aesthetic judgments and the ability to apply them to works of art.
- 3.3 Ability to use cultural resources of museums, libraries, theaters, historic sites, and performing arts groups.
- 3.4 Ability to produce or perform works in at least one major art form.
- 3.5 Materials, media, and history of major art forms.
- 3.6 Understanding of the diversity of cultural heritages.

4. Each student will acquire knowledge about political, economic, and social institutions and procedures in this country and other countries. Included are:
- 4.1 Knowledge of American political, economic, and social processes and policies at national, state and local levels.
- 4.2 Knowledge of political, economic, and social institutions and procedures in various nations; ability to compare the operation of such institutions; and, understanding of the international interdependence of political, economic, social, cultural and environmental systems.

5. **Each student will respect and practice basic civic values and acquire the skills, knowledge, understanding, and attitudes necessary to participate in democratic self-government. Included are:**
   - **5.1 Understanding and acceptance of the values of justice, honesty, self-discipline, due process, equality, and majority rule with respect for minority rights.**
   - **5.2 Respect for self, others and property as integral to a self-governing, democratic society.**
   - **5.3 Ability to apply reasoning skills and the process of democratic government to resolve societal problems and disputes.**

6. Each student will develop the ability to understand, respect, and accept people of different race; sex; ability; cultural heritage; national origin; religion; and political, economic and social background, and their values, beliefs, and attitudes.

7. **Each student will acquire knowledge of the ecological consequences of choices in the use of the environment and natural resources.**

8. **Each student will develop general career skills, attitudes and work habits and make a self-assessment of career prospects. Students not directly pursuing postsecondary education will acquire entry-level employment skills.**

9. **Each student will learn knowledge, skills, and attitudes that enable development of:**
   - **9.1 Self-esteem.**
   - 9.2 The ability to maintain physical, mental and emotional health.
   - 9.3 Understanding of the ill effects of alcohol, tobacco and other drugs.

10. **Each student will develop a commitment to lifetime learning with the capacity for undertaking new studies, synthesizing new knowledge and experience with the known, and refining the ability to judge.**

*Boldfaced type is used to highlight the Regents Goals that a good elementary science program will help to develop.

New York Energy Education Project

APPENDIX B

EXCERPTS FROM A NATIONAL SCIENCE TEACHERS ASSOCIATION POSITION STATEMENT

Science-Technology-Society Science Education for the 1980's

The goal of science education during the 1980's is to develop scientifically literate individuals who understand how science, technology, and society influence one another and who are able to use this knowledge in their everyday decision making. The scientifically literate person has a substantial knowledge base of facts, concepts, conceptual networks, and process skills which enable the individual to continue to learn and think logically. This individual both appreciates the value of science and technology in society and understands their limitations.

The attributes listed below help to describe a scientifically literate person. Each attribute should be thought of as describing a continuum along which the individual may progress. The progress of the individual's science education should be equated with progress along this continuum.

The scientifically and technologically literate person:

—uses science concepts, process skills, and values in making responsible everyday decisions;
—understands how society influences science and technology as well as how science and technology influence society;
—understands that society controls science and technology through the allocation of resources;
—recognizes the limitations as well as the usefulness of science and technology in advancing human welfare;
—knows the major concepts, hypotheses, and theories of science and is able to use them;
—appreciates science and technology for the intellectual stimulus they provide;
—understands that the generation of scientific knowledge depends upon the inquiry process and upon conceptual theories;
—distinguishes between scientific evidence and personal opinion;
—recognizes the origin of science and understands that scientific knowledge is tentative and subject to change as evidence accumulates;
—understands the applications of technology and the decisions entailed in the use of technology;
—has sufficient knowledge and experience to appreciate the worthiness of research and technological development;
—has a richer and more exciting view of the world as the result of science education; and
—knows reliable sources of scientific and technological information and uses these sources in the process of decision making.

Recommendations for K-12 Grade Levels

Elementary School Science — Science should be an integral part of the elementary school program. It should be used to integrate, reinforce, and enhance the other basic curricular areas so as to make learning more meaningful for children.

A carefully planned and articulated elementary science curriculum should provide daily opportunities for the sequential development of basic physical and life science concepts, along with the development of science process and inquiry skills.

Elementary science should provide opportunities for nurturing children's natural curiosity. This helps them to develop confidence to question and seek answers based upon evidence and independent thinking. Children should be given an opportunity to explore and investigate their world using a hands-on approach, with instructional materials readily available.

The focus of the elementary science program should be on fostering in children an understanding of, an interest in, and an appreciation of the world in which they live.

Time on Science Learning —
—Lower elementary level (grades K-3) a minimum of 1½ hours/week of science should be required.
—Upper elementary level (grades 4-6) a minimum 2½ hours/week of science should be required.

Emphasis on Programs for All Students —
—In elementary, middle, junior high, and senior high school grades, science education programs should provide basic concepts for all students. Opportunities should be available for students with diverse interests and commitments, including students with exceptional interests and talents in science.

Emphasis on Laboratory and Field Activities —
—Elementary-level laboratory and field activities should stress the development of basic inquiry skills.

Science Instruction Matches Students' Cognitive, Physical, Social, and Emotional Development —
—Schools should provide objectives, content, and instructional strategies that are appropriate to the student's stage of mental, moral, and physical development.
—Varying strategies and materials should be provided at all grades to accommodate students with various levels of learning skills and mental development.

Emphasis on Science-Related Social Issues —
—Elementary level; a minimum of five percent of science instruction should be directed toward science-related societal issues.

The entire NSTA Position Statement was adopted unanimously by the Board of Directors in 1982. Additional copies of the entire position statement are available; write to the National Science Teachers Association, 1742 Connecticut Avenue NW, Washington, DC 20009.

APPENDIX C

ELEMENTARY SCIENCE GOALS AND CRITERIA AT A GLANCE

...a scientifically literate person is a problem solver...

SYLLABUS GOAL: Students will demonstrate an increase in their scientific literacy.

...an effective problem solver uses a systematic model...

PROGRAM GOAL: Students will solve problems effectively and with ease.

Students should learn:

—specific steps in a problem-solving model;
—how skills, positive science attitudes, and science principles relate to problem solving; and
—how to apply a problem solving model to solve problems.

...skills are the tools used in effective problem solving...

PROGRAM GOAL: Students will apply skills systematically and with ease to solve problems.

Students should learn and apply:
—inquiry skills, including mathematical skills, and
—language arts skills and processes needed to solve problems.

...an effective problem solver expresses positive science attitudes...

PROGRAM GOAL: Students will develop positive science attitudes.

Students should demonstrate an increased capacity to:

—appreciate nature and enjoy the process of studying about it, and
—value the use of what is known about the natural world for the benefit of present and future generations.

...an effective problem solver must be knowledgeable...

PROGRAM GOAL: Students will increase their understanding of science principles.

Students should gain an increased understanding that:

I.
Living things (objects), including plants and animals, live and thrive when their needs are met; and plants and animals are dependent on other plants and animals.

Objects and events have distinctive properties; and the properties of an object can be changed by an event (interaction) in which the object is involved.

II.
Each kind of plant and animal continues beyond the life span of the individuals because each kind is able to produce offspring; and different kinds of plants and animals in an area may be dependent upon each other for food and other needs.

Energy and materials have forms and properties; and within systems the interactions of materials and energy change their forms and properties.

III.
Living things are affected by and affect the environment; and environmental conditions in an area determine the types and sizes of populations of plants and animals within a community and affect the way the populations interact.

Energy may exist within a material or in the position or motion of objects; and material and energy can be transferred several times within a complex system through a series of interactions.

In an ecosystem, energy and material can be transferred through a series of interactions of the living community with its physical environment.

...effective program activities use a problem-solving approach...

PROGRAM CRITERION: Program activities will use a problem-solving approach.

...effective program activities always correlate with the syllabus...

PROGRAM CRITERION: Program activities should always correlate directly to the skills, science attitudes, and science content in the syllabus.

APPENDIX D

SAFETY – DEVELOPMENT OF DISTRICT POLICIES FOR EYE PROTECTION: SUGGESTED GUIDELINES*

The amended Regulations of the Commissioner of Education of the State of New York effective March 1, 1971, outline in general terms the time and place when eye-protective devices should be worn. Boards of education are urged to adopt rules for implementing the Law and Regulations of the Commissioner of Education. Industrial quality eye-protective devices as used in the Regulation are defined as those devices meeting standards of the AMERICAN NATIONAL STANDARD PRACTICE FOR OCCUPATIONAL AND EDUCATIONAL EYE AND FACE PROTECTION, Z87.1-1968, promulgated by the American National Standards Institute, Inc.

Therefore, the following are provided as guides to implementation of eye-safety programs. It is suggested:

- That school districts formulate specific policies for the implementation of eye-protection programs.
- That school district committees for developing district policy relating to eye-safety devices include:
  - —professional staff members representing instructional areas
  - —community resource persons familiar with industrial eye-safety programs
  - —school district insurance representative(s)
  - —optometrist or other medical authority
  - —school district legal authority
- That policies be reviewed periodically to implement amendments to the legislation and the Regulations of the Commissioner.
- That suppliers be required to meet or exceed the standards of the American Standard Practices for Occupational and Educational Eye and Face Protection, Z87.1-1968, promulgated by the American National Standards Institute, Inc.
- That sanitary storage facilities relating to eye-protective devices be planned for each shop, laboratory, or instructional area where eye-protective devices are required.
- That quality eye-safety devices be available for the protection of all students in classes where potential hazards exist.

* These guidelines were included in the body of a letter to the field from the State Education Department, February 1973.

Elmira City School District

APPENDIX E

SOME SAFETY SUGGESTIONS

1. Do not permit students to handle science supplies, chemicals, or equipment in the classroom until they have been given specific instructions in their use.
2. Instruct students to report immediately to the teacher:
   - —any equipment in the classroom that appears to be in an unusual or improper condition, or
   - —any chemical reactions that appear to be proceeding in an abnormal fashion, or
   - —any personal injury or damage to clothing caused by a science activity, no matter how trivial it may appear.
3. Prevent loose clothing and hair from coming into contact with any science supplies, chemicals, equipment, or sources of heat or flame.
4. Do not allow science materials, such as chemicals, to be transported through hallways by unsupervised students or during a time when students are moving in the hallways.
5. Instruct students in the proper use of sharp instruments such as pins, knives, and scissors before they use such objects.
6. Instruct students never to touch, taste, or inhale unknown chemicals directly.
7. Instruct students never to pour chemicals (reagents) back into stock bottles and never to exchange stoppers or caps on bottles.
8. Warn students of dangers in handling hot glassware or other equipment. Be sure proper devices for handling hot objects are available.
9. Check electrical wiring on science equipment for frayed insulation, exposed wires, and loose connections.
10. Instruct students in the proper use of eye-protection devices before they do activities in which there is a potential risk to eye safety.
11. Give appropriate, specific safety instructions prior to conducting any activity in which there is a potential risk to student safety and provide appropriate reminders during the activity.
12. Instruct students in the location and use of specialized safety equipment such as fire extinguishers, fire blankets, or eye baths when that equipment might be required by the science activity.
13. Instruct students in the proper care and handling of classroom pets, fish, plants, or other live organisms used as part of science activities.
14. Have sufficient lighting to ensure that activities can be conducted safely.
15. Ensure safe access to the facility, equipment, and materials for students with handicapping conditions. Consider:
    - —access to laboratories and equipment, placement of chemicals, distances required for reaching, and height and arrangement of tables.
    - —physical accessibility to equipment needed in cases of emergency.
16. Provide practice sessions for safety procedures.

Elmira City School District

APPENDIX F

GUIDELINES FOR THE USE OF VERTEBRATE ANIMALS IN ELEMENTARY AND SECONDARY SCHOOL PROGRAMS OF NEW YORK STATE

The study of living things is essential to effective instruction in the life sciences including agriculture. If students are not given the opportunity to study directly living organisms, they will be deprived of basic understandings necessary to comprehend and appreciate life and life processes and to develop competencies needed in agriculture and science-related careers.

The teacher's primary goals for demonstrations and investigations involving animals are to achieve an interest in and an understanding of the life processes, to demonstrate biological principles, and to teach proper care and handling of animals. Such instructional activities, investigations, and projects must be well planned and adequately supervised, and must be conducted with a respect for life and an appreciation of the health and safety of both the animals and the students. Well-planned investigations or projects should include appropriate preparation and an outline of the stages of the activity. In student-designed activities, both the initial plan and subsequent modifications must be approved by the instructor.

In any segment of society, the abuse of any living animals for experimentation or any other purpose is intolerable. Because agriculture and the life sciences deal specifically with living things, educators must be especially cognizant of their responsibility to insure the humane treatment of living organisms. This responsibility to encourage humane treatment of animals should extend beyond the confines of the teacher's classroom.

In harmony with Section 809 of the New York State Education Law, these guidelines should be followed when studying vertebrate animals in all elementary and secondary school programs in New York State.

A. Biological studies should lead to and be consistent with a respect for life and all living things. Proper treatment and care of animals should be an integral part of any lesson that includes living animals.

B. Investigations dealing with animals must be within the comprehension and capabilities of the students involved. It is recognized that within a group of students capabilities may vary; however, it is expected that a competent teacher can determine an appropriate level of investigation for a group or for an individual student.

C. Lower orders of life such as protists and invertebrates can reveal much basic biological information, and when possible, should be used as subjects for invasive studies.

D. Vertebrate animals are appropriate objects of study when students:

1. observe normal living patterns of wild animals in the free living state or in zoological parks, gardens, or aquaria;
2. observe normal living patterns of pets, fish, or domestic animals;
3. observe biological phenomena involved with (a) embryonic development, (b) inducing ovulation in frogs, (c) imprinting studies, (d) positive reinforcement studies, (e) environmental studies, and (f) anatomical and physiological studies;
4. gain direct, practical experience in developing skills in standard practices used when working with domestic and wild animals.

E. Vertebrate animals used in instruction should be properly cared for.

1. The procurement and use of wild or domestic animals must comply with existing local, State, or Federal regulations. Teachers should assure that live animals entering a classroom are healthy and free from transmissible disease or other conditions that may endanger the health of humans or other animals. Some wild animals are not appropriate for classroom use because they may be carriers of parasites and disease and/or do not adapt well to the conditions imposed by captivity. The use of wild animals as pets should be strongly discouraged.
2. The care of animals should be supervised by a teacher knowledgeable about proper animal care. An animal may be taken to a student's home only with permission from the parent, and should be provided with conditions similar to those prescribed for classrooms.
3. Animals being studied must have appropriate quarters which are cleaned regularly; sufficient space for the normal behavior and postural requirements of the species; proper ventilation, lighting, and temperature control. Adequate food and clean drinking water shall be available. Quarters should be in a place where undue stress and disturbance are minimized.
4. For reasons of conservation, efforts should be made to protect depleted animal species such as *Rana pipiens* (leopard frog). The same educational objectives can frequently be achieved using alternative species or pursuing alternative methods of study.
5. Adequate plans should be made to separate the sexes to control possible unwanted breeding of the species during the project.
6. Preliminary plans should include provisions for the proper disposition of the animals at the conclusion of the study or instructional unit.

Laboratory-bred or non-native species must not be released into the wild. Native animals should be acclimated to their natural habitat before release.

7. The plan for an extracurricular project involving animals should be reviewed by a qualified adult supervisor before the project begins. An extracurricular project should be conducted in a suitable area in the school or at a site approved by that supervisor.
8. Supervised occupational experience programs usually require the use of animals owned by students, parents, employers, or the school. Prior to the use of these animals, instruction on the proper care of the animal must have been provided.

F. Studies using vertebrates should be carried out with a respect for life.

1. Animal studies should be carried out under the supervision of a qualified teacher. A student should not be allowed to take the animal home to carry out an experimental study. Such a study should be done in a suitable area in the school. A student may, however, take an animal home during periods when school is not in session in order to provide suitable care.
2. No live vertebrate animal should have performed on it a lesson or experimental study that employs (a) micro-organisms which cause disease in man or animal, (b) ionizing radiation, (c) known cancer-producing agents, (d) chemicals at toxic levels, (e) drugs producing pain or deformity, (f) extremes of temperature, (g) electric or other shock, (h) excessive noise, (i) noxious fumes, (j) exercise to exhaustion, (k) overcrowding, (l) paralysis by muscle relaxants, (m) starvation, or (n) other extreme stimuli.
3. If bird embryos are subjected to invasive or potentially damaging experimental manipulations, the embryos' development must be terminated three days prior to hatching. If normal embryos are to be hatched, satisfactory provisions must be made for the care of the young birds.
4. On rare occasions the performance of a surgical procedure or the need to terminate the life of an animal for educational purposes may be necessary. Such use of vertebrates is not appropriate below the secondary level. Surgical procedures should only be performed under the immediate supervision of a biomedical scientist using appropriate anesthesia and facilities properly equipped to carry out such procedures. This person must have an appropriate advanced degree such as a Ph.D., M.D., D.V.M., D.D.S., and must be actively engaged in the field under investigation. Agriculture practices such as tail docking, dehorning, and castration should be taught under the supervision of a qualified agriculture teacher. Terminating the life of an animal shall be done in a rapid and painless manner by a person trained and proficient in these techniques. Maximum efforts should be made to study as many biological principles and utilize as many body tissues as possible from a single animal.
5. A project which involves living vertebrates must display a statement signed by both the teacher and the student to certify strict adherence to these guidelines.

SELECTED REFERENCES

This document is in part based upon individual items or modifications of guidelines taken from the following:

American Humane Society. *Guiding Principles for the Use of Animals by Secondary School Students and Science Club Members.*

Canadian Council on Animal Care. *Guiding Principles Governing the Use of Animals in the Classroom at the Pre-University Level.*

The Humane Society of the United States. *Guiding Principles for the Use of Animals in Elementary and Secondary Education.*

National Association of Biology Teachers. *Guidelines for the Use of Live Animals at the Pre-University Level.*

National Society for Medical Research. *Guiding Principles in the Use of Animals by Secondary School Students and Science Club Members.*

New York State Education Department. *The Humane Treatment of Animals, A Guide for Elementary Teachers.*

State of Indiana. *Guidelines in the Use of Animals by Elementary and Secondary School Students.*

APPENDIX G

SYLLABUS - PROGRAM CORRELATION CHART
LEVELS I, II, & III

		ACTIVITIES
	Time Emphasis (Days)	
INQUIRY SKILLS	CLASSIFYING	
	CREATING MODELS	
	FORMULATING HYPOTHESES	
	GENERALIZING	
	IDENTIFYING VARIABLES	
	INFERRING	
	INTERPRETING DATA	
	MAKING DECISIONS	
	MANIPULATING MATERIALS	
	MEASURING	
	OBSERVING	
	PREDICTING	
	RECORDING DATA	
	REPLICATING	
	USING NUMBERS	
LANGUAGE ARTS SKILLS/ PROCESSES	CLASSIFYING	
	DEVELOPING VOCABULARY	
	MANIPULATING IDEAS	
	QUESTIONING	
	RECORDING DATA	
	USING CUES	
	ACQUIRING INFORMATION	
	COMMUNICATING INFORMATION	
SCIENCE ATTITUDES	A. APPRECIATING, ENJOYING, NATURE	
	1. UNDERSTANDING, NATURAL WORLD	
	1.1 APPRECIATING NATURAL WORLD	
	1.11 COMPLEXITY, DIVERSITY, INTRICACY, ETC.	
	1.12 RESOURCE, HUMAN NEEDS	
	1.2 RESPECTING LIFE	
	1.21 INDIVIDUAL LIFE, PRECIOUS	
	1.22 SOURCE FOR CONTINUATION	
	1.23 AGING PROCESS	
	1.3 WANTING TO KNOW, UNDERSTAND	
	1.31 CONCEPTS, TERMS, TECHNIQUES, ETC.	
	1.32 ACCURATE INFORMATION	
	1.33 EXPLANATIONS, INTERPRETATIONS, PREDICTIONS	
	2. INVESTIGATIVE METHODS, NATURAL WORLD	
	2.1 SKEPTICISM, INVESTIGATION, REASONING	
	2.11 UNCERTAINTY OF INFORMATION, VERIFICATION	
	2.12 AMBIGUITY, CONTRADICTION, TENTATIVENESS	
	2.13 ORIGINAL INSIGHT, INFERENCES, ETC.	
	2.14 CAREFUL, SYSTEMATIC INVESTIGATION	
	2.15 LOGICAL REASONING, VALIDITY OF IDEAS	
	2.2 RESPECTING OTHERS, ENVIRONMENT	
	2.21 SAFETY	
	2.22 USE OF RESOURCES	
	2.23 CONTRIBUTING FAIR SHARE OF EFFORT	
	2.24 CONTRIBUTIONS, OTHERS	
	2.25 TRUTHFUL REPORTING	
	2.26 BELIEFS AND VALUES OF OTHERS	
	B. VALUING USE OF KNOWLEDGE FOR SOCIETY	
	1. THE PRACTICAL, TECHNICAL	
	1.1 SCIENTIFIC TECHNIQUES, MATERIALS	
	1.2 RESOURCEFULNESS, INNOVATIVENESS	
	1.3 TECHNIQUE EFFICIENCY, SIMPLICITY, ETC.	
	2. SERVICE THROUGH TECHNOLOGY	
	2.1 NEEDS, PROBLEMS OF OTHERS	
	2.2 BENEFITS OF TECHNOLOGICAL CHANGE	
	2.3 POTENTIAL ADVERSE CONSEQUENCES	

Attach next page along this line.

LIFE SCIENCE (LEVEL I)	I. NATURAL WORLD
	IA. PLANTS, ANIMALS, NEEDS
	1. PLANTS, PROPERTIES, NEEDS
	1.1 PLANT PARTS, FUNCTIONS
	1.11 ROOTS
	1.12 LEAVES
	1.13 STEMS, STALKS, TRUNKS, ETC.
	1.2 PLANT PARTS, IMMEDIATE NEEDS
	1.3 PLANT PARTS, SEASONAL CHANGES
	1.4 PLANT GROWTH AND DEVELOPMENT, LIFE SPAN
	1.41 SEED, SEEDLING, ADULT
	1.42 BULB, YOUNG PLANT, MATURE PLANT
	1.43 LENGTH OF LIFE SPAN
	1.5 PLANT PART VARIATIONS
	2. ANIMALS, PROPERTIES, NEEDS
	2.1 ANIMAL PARTS, FUNCTIONS
	2.11 WINGS, LEGS, FINS
	2.12 MOUTH, TEETH, JAWS, TONGUE
	2.13 NOSTRIL
	2.14 EYES, NOSE, EARS, TONGUE, SKIN
	2.15 CLAWS, SHELLS, ETC.
	2.16 BODY COVERING
	2.17 PARTS, SOUND
	2.2 ANIMAL PARTS, IMMEDIATE NEEDS
	2.3 ANIMAL PARTS, SEASONAL NEEDS
	2.4 ANIMAL GROWTH AND DEVELOPMENT, LIFE SPAN
	2.41 INFANCY TO ADULT STAGES
	2.42 LENGTH OF LIFE SPAN
	2.5 ANIMALS, CONTROL CONDITIONS, NEEDS
	2.6 ANIMALS, MOTION, NEEDS
	2.7 ANIMAL PART VARIATIONS
	IB. PLANTS, ANIMALS, DEPENDENCY
	1. ANIMALS — PLANTS
	2. PLANTS — ANIMALS
	3. ANIMALS — ANIMALS
PHYSICAL SCIENCE (LEVEL I)	IC. OBJECTS, EVENTS, PROPERTIES
	1. OBJECT PROPERTIES, MATERIAL, CONDITION
	1.1 OBJECT PROPERTIES, MATERIAL
	1.11 DIFFERENT MATERIALS/PROPERTIES
	1.12 CHANGING SIZE, SHAPE
	1.13 SOLID, LIQUID, GAS
	1.14 MIXTURES
	1.2 OBJECT PROPERTIES, LOCATION IN SPACE
	1.3 OBJECT PROPERTIES, AMOUNT OF SPACE
	1.4 TWO OBJECTS, SAME SPACE
	1.5 OBJECT PROPERTIES, SURROUNDING CONDITIONS
	2. EVENT PROPERTIES, OBJECTS, SPACE, TIME
	2.1 EVENT, TIME, PLACE IN SPACE
	2.2 EVENT, DURATION OF TIME
	2.3 EVENTS, SEQUENCE, ORDER, SPACE
	2.4 TWO EVENTS, TIME
	2.5 REPEATING EVENTS, INTERVALS OF TIME
	2.6 EVENTS, MOTION, SPACE
	ID. INTERACTION, OBJECTS, EVENTS
	1. OBJECTS — HEAT
	1.1 HEATING, COOLING, WARMER, COLDER
	1.2 HEATING MATERIALS, LIQUIDS, GASES
	1.3 COOLING MATERIAL, LIQUIDS, SOLIDS
	1.4 HEATING, COOLING, VOLUME CHANGE
	2. OBJECT, MOTION, PUSH-PULL
	2.1 DIRECTION OF PUSH-PULL, CHANGE IN MOTION
	2.2 SIZE OF PUSH-PULL, OBJECT MASSIVENESS, MOTION
	2.3 SURFACE CONDITION, SIZE OF PUSH-PULL, MOTION
	3. OBJECTS, SUPPORTED BY OBJECTS
	3.1 UNIFORM BALANCE BEAM
	3.11 TWO OBJECTS, EQUAL WEIGHT, BALANCE POINT
	3.12 TWO OBJECTS, DIFF. WEIGHT, BALANCE POINT
	3.2 OBJECTS, FLOATING, SINKING

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LIFE SCIENCE (LEVEL II)	IIA. PLANTS, ANIMALS, NEW GENERATIONS
	1. FLOWERS, SUFFICIENT SEEDS, SURVIVAL, NEW GENERATION
	1.1 GENERATION, STAGES, LIFE CYCLE
	1.2 FLOWERS, SEEDS
	1.21 POLLEN TRANSFER, SEEDS
	1.22 POLLEN TRANSFER AIDS
	1.23 SEEDS, FRUIT
	1.3 SEED CHARACTERISTICS, SURVIVAL
	1.31 DISPERSAL
	1.32 SEVERE CONDITIONS, TEMPERATURE, DROUGHT
	1.33 GERMINATION, SUITABLE CONDITIONS
	1.34 STORED FOOD
	1.4 OTHER STRUCTURES, OFFSPRING
	1.5 PLANT POTENTIAL FOR OFFSPRING
	1.51 NUMBERS OF FLOWERS, SEEDS
	1.52 ACTUAL CONDITIONS, SURVIVAL, POPULATION
	2. ADULT ANIMALS, SUFFICIENT YOUNG, SURVIVAL, NEW GEN.
	2.1 GENERATION, STAGES, LIFE CYCLE
	2.2 CARE FROM ADULTS, LIVE, THRIVE
	2.3 YOUNG ANIMALS, LIVE, THRIVE, INDEPENDENT
	2.4 ANIMAL POTENTIAL FOR OFFSPRING
	2.41 ACTUAL CONDITIONS, SURVIVAL, POPULATION
	IIB. DIFFERENT KINDS, PLANTS, ANIMALS, DEPENDENCY, COMMUNITY
	1. PLANTS, ANIMAL FOOD SUPPLY, SUN ENERGY
	1.1 FOOD CHAIN
	1.2 FOOD WEB
	2. POPULATION SIZE, DEPENDENCIES, FOOD
	2.1 ANIMAL POPULATION, FOOD SUPPLY
	2.2 ANIMAL POPULATION CHANGE, FOOD SUPPLY CHANGES
PHYSICAL SCIENCE (LEVEL II)	IIC. ENERGY, MATERIAL, FORMS, PROPERTIES
	1. OBJECT PROPERTIES, FORMS, AMTS., PROP. OF MATERIALS
	1.1 OBJECT PROPERTIES, FORM
	1.11 SHAPE
	1.12 SOLID, LIQUID, GAS
	1.13 SIZE OF CONTAINED SOLID PARTICLES
	1.2 OBJECT PROPERTIES, AMOUNT OF MATERIAL
	2. ENERGY FORM, AMOUNT, ABILITY TO MOVE
	2.1 ENERGY FORMS
	2.2 ENERGY MOVEMENT, BETWEEN, THROUGH
	2.3 ENERGY, AMOUNTS AVAILABLE
	IID. INTERACTIONS, MATERIALS, ENERGY, SYSTEMS
	1. ENERGY CHANGES, INTERACTIONS
	2. ENERGY TRANSFER, SYSTEM
	3. ENERGY, INTERACTION, OBJECT PROPERTIES

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LIFE SCIENCE (LEVEL III)	IIIA. LIVING THINGS, EFFECT ON ENVIRONMENT
	1. LIFE OF PLANT, ENVIRONMENTAL CONDITIONS
	1.1 PLANT HEALTH, GROWTH, DEVELOPMENT
	1.2 PLANT CHANGE, ENVIRONMENTAL CHANGE, SURVIVAL
	1.21 PLANT PART MOVEMENT
	1.22 PLANT PART FORMATION
	1.3 GREEN PLANT, LIGHT ENERGY
	1.31 LEAVES, LIGHT ABSORPTION, ENERGY TRANSFORM.
	1.32 ABSORBED AND STORED ENERGY, UTILIZATION
	1.33 STORED ENERGY, FOOD SUPPLY, SEED, GROWING PLANT
	1.4 PLANTS, AFFECT, ENVIRONMENT
	2. LIFE OF ANIMAL, ENVIRONMENTAL CONDITIONS
	2.1 ANIMAL HEALTH, GROWTH, DEVELOPMENT
	2.2 ANIMAL BEHAVIOR CHANGE, ENVIRONMENTAL CHANGE
	2.21 ANIMALS MOVEMENT, OPTIMAL CONDITIONS
	2.22 ANIMAL CHARACTERISTICS, ENVIRON. INFLUENCE
	2.23 ROUTINE BEHAVIOR, ENVIRONMENTAL INFLUENCE
	2.3 SOURCES OF ENERGY
	2.31 STORED ENERGY, FOOD
	2.32 HEAT ENERGY, SUN
	2.33 HEAT ENERGY, FUEL UTILIZATION
	2.4 ANIMAL BEHAVIOR, AFFECT, ENVIRONMENT
	IIIB. ENVIRON. CONDITIONS, INFLUENCE, POPULATIONS, COMMUNITY
	1. DIFFERENT KINDS, POPULATIONS, VARIOUS ENVIRONMENTS
	2. ENVIRONMENTAL CONDITION CHANGE, POP. SIZE CHANGE
	2.1 CONDITIONS, DIRECT EFFECT, POPULATION SIZES
	2.2 CONDITIONS, DIRECT EFFECT, FOOD CHAIN
PHYSICAL SCIENCE (LEVEL III)	IIIC. ENERGY, WITHIN MATERIAL, POSITION, MOTION, OBJECTS
	1. ENERGY TRANSFER WITHIN MATERIALS
	1.1 ELECTRICAL ENERGY, CIRCUITS
	1.11 POSITIVE, NEGATIVE CHARGES
	1.12 BATTERIES, ENERGY STORAGE
	1.13 COMPLETE CIRCUIT, ENERGY FLOW
	1.14 RATE OF FLOW, VOLTAGE, TRANSFER AMOUNT
	1.15 MAGNETIC FIELD, FLOWING ELECTRICITY
	1.16 MOVING MAGNET, FLOW OF ELECTRICITY
	1.2 INTERACTIONS, MATERIALS, ENERGY
	1.21 NEW MATERIALS
	1.22 STARTING ENERGY
	1.23 ENERGY EMITTED
	1.24 ENERGY ABSORBED
	1.3 HEAT FLOW
	1.31 AMOUNT OF MATERIAL
	1.32 TYPES OF MATERIAL
	1.33 TEMPERATURE DIFFERENCE
	1.34 MOVEMENT OF MATERIAL
	2. ENERGY TRANSFER, MOTION, OBJECTS
	2.1 WORK, ENERGY TRANSFER
	2.11 LIFTING OBJECTS, HEIGHT
	2.12 MOVING OBJECTS, SPEED
	2.2 AMOUNT OF WORK, FORCE, DISTANCE
	2.21 INCLINED PLANE, LEVER, CHANGING FORCE
	2.22 SIMPLE MACHINES, CHANGING DISTANCE
	2.23 MACHINE, OBJECT-FORCE-DISTANCE RELATIONSHIP
	2.3 MAN-MADE TOOLS, MACHINES
	2.4 FORCES, LIQUIDS, GASES
	2.41 CLOSED CONTAINER, FORCE
	2.42 FORCE, AREA, PRESSURE
	2.43 PRESSURE, DEPTH, FLUID
	IIID. MATERIAL AND ENERGY TRANSFER, INTERACTIONS, SYSTEMS
	1. CHANGES IN FORM
	2. CHANGES IN LOCATION
	3. LOSSES FROM A SYSTEM

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ECOSYSTEMS	IIIE. ECOSYSTEM
	1. MATERIAL RECYCLING, PHYS. ENVIRON., LIVING COMMUNITY
	1.1 MATERIAL ABSORPTION, GREEN PLANTS
	1.2 MATERIAL ABSORPTION, ANIMALS
	1.3 MATERIAL UTILIZATION, WASTE
	1.4 MATERIAL DECAY
	2. ENERGY TRANSFER, PHYS. ENVIRON., LIVING COMMUNITY
	2.1 ENERGY INPUT, PHYSICAL ENVIRONMENT
	2.11 ENERGY ABSORPTION, AIR, WATER, LAND
	2.12 ENERGY, CLOUDS, RAIN
	2.13 ENERGY, WINDS, WAVES
	2.2 ENERGY INPUT, LIVING COMMUNITY
	2.21 SOLAR ENERGY, ABSORP., GREEN PLANT UTIL.
	2.22 STORED ENERGY, PLANTS, ANIMAL UTILIZATION
	2.23 ENERGY ENCH., DEAD PLANTS – ANIMALS DECAY
	3. INTERACTIONS, CAUSE AND EFFECT, ECOSYSTEM PARTS

APPENDIX H

STUDENTS WITH HANDICAPPING CONDITIONS

Students who are educationally handicapped have been classified by the local school district Committee on the Handicapped (COH) and receive special education to the extent needed for progress in schools. Most students who require special education attend regular classes in conjunction with specialized instruction and/or related services. In addition to special education programs, such students must have access to the full range of programs and services provided by the school district. No student can be denied membership or participation in curricular or extracurricular activities on the basis of a disability. It is important that students with handicapping conditions are ensured of access to the total school program.

The vast majority of students with disabilities have the potential intellectual capacity to master the curricula content requirements for a high school diploma. Such students must attain the same academic standards as their nonhandicapped peers in order to meet these requirements. For this reason, it is very important at the elementary level for students with handicapping conditions to receive instruction in the same content areas. It is important that such students receive the same informational base that will be required for proficiency on statewide testing programs and for future diploma requirements.

The teachers providing instruction through this syllabus should become aware of the needs of students with handicapping conditions in their class. Instructional techniques and materials must be modified so that the information included within this curriculum can be attained for such students. Using various and creative instructional strategies will help all students and especially assist students with learning problems. Special education personnel and/or the Committee on the Handicapped should be used as possible resources, additional information, and support.

Schenectady Community Headstart Program

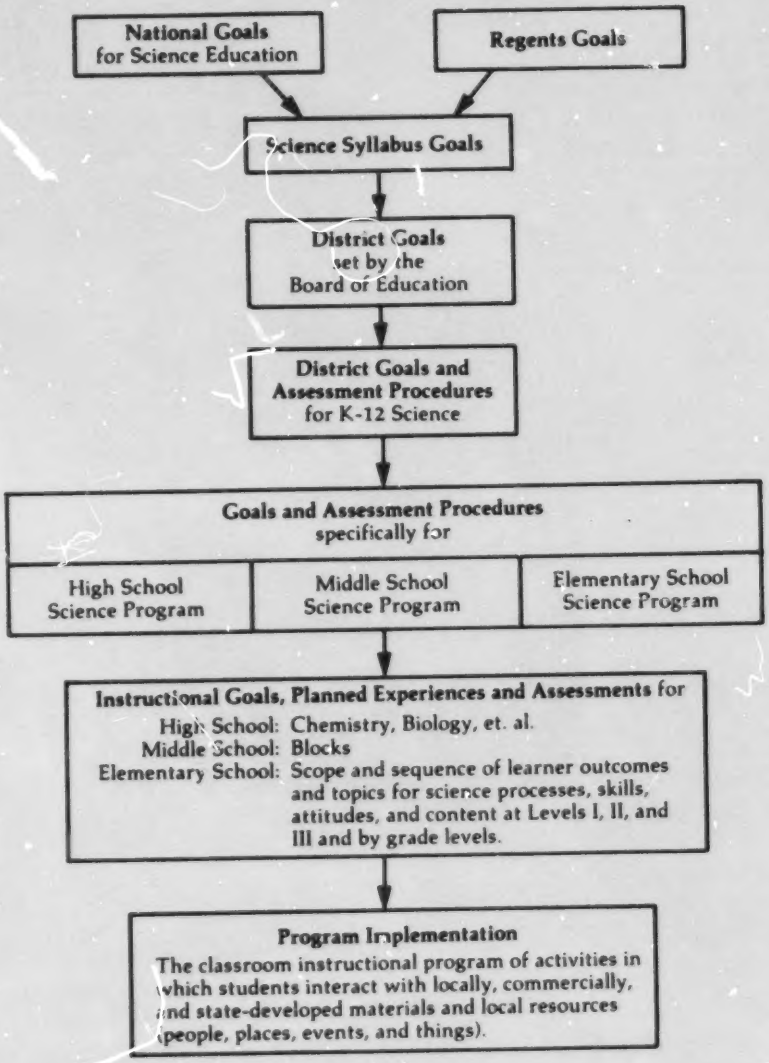
APPENDIX I

PROGRAM DEVELOPMENT AT THE LOCAL LEVEL

OVERVIEW

A good elementary science program has goals, planned and approved experiences, and means of assessment at each grade level. It is coordinated with the middle school and high school programs, and together, they make up the district science program for K-12.

The K-12 district program goals for science are broad statements that give general direction and continuity to teachers' efforts at each grade level. They give members of the community as well as educators the big picture of what students are expected to do as a result of studying science. The goals tell what major processes, skills, attitudes, and knowledge students are expected to have when they graduate from high school. District program goals for science should be based on the broad goals established by the school district, State Education Department syllabi, and the Statement of Regents Goals for Elementary and Secondary Education in New York State. These relationships are shown below:


National Goals for Science Education
Regents Goals
Science Syllabus Goals
District Goals set by the Board of Education
District Goals and Assessment Procedures for K-12 Science
Goals and Assessment Procedures specifically for
High School Science Program
Middle School Science Program
Elementary School Science Program
Instructional Goals, Planned Experiences and Assessments for
High School: Chemistry, Biology, et. al.
Middle School: Blocks
Elementary School: Scope and sequence of learner outcomes and topics for science processes, skills, attitudes, and content at Levels I, II, and III and by grade levels.
Program Implementation
The classroom instructional program of activities in which students interact with locally, commercially, and state-developed materials and local resources (people, places, events, and things).

Statements of Goals or Learner Outcomes

Developing specific outcomes for each grade is an important step in implementing your program. They are the basis for these questions which teachers must ask themselves when they plan experiences for students:

—What will the students do in science today?
—Why?
—How will I know what they accomplished?

Below are some examples of goals, or learner outcomes, that show the evolution from broad statements of learner outcomes to precise statements for classroom use.

Regents Goal:

Each student will learn methods of inquiry and knowledge gained through the natural sciences and use the methods and knowledge in interdisciplinary applications. (Regents Goal 2.4)

A District Goal:

- Students will understand how science, technology, and society influence one another and students will use their knowledge, skills, and positive attitudes to solve everyday problems.

A K-12 Program Goal for Science Education:

- K-12 students will solve science-related problems by using appropriate skills in ways that demonstrate positive science attitudes and an understanding of life and physical science principles.

K-6 Program Goals (adopted from the syllabus):

- Students will increase their understanding of science principles.

Grade 1 Goal:

- Students will demonstrate an understanding that each plant has properties that enable the plant to meet its needs.

Grade 1 Goal for an Instructional Unit or Lesson:

- Students will identify plant parts including roots, stems, and leaves from several green plants.

Planning and Development

The development of a good science program should involve classroom teachers, special education teachers, supervisors, administrators, and chairpersons, and, where appropriate, parents, members of the community, and students. Their job is to design a K-12 science program directed toward the systematic accomplishment of the goals provided by the Regents, State Education Department science syllabi and the local Board of Education. The elementary program should be articulated with the middle school and high school science programs in order to provide continuity for students' growth and development. It is important for the following reasons that a district science program be developed:

—The district science program is the link between broad district goals and classroom teachers' efforts.
—It is a comprehensive set of related goals that makes a systematic whole. It provides for development of students' knowledge, attitudes, and skills, over a long period of time. It is not a "course" that lasts for only a year.
—It provides continuity and direction for teachers' efforts at each grade level. For instance, a third-grade teacher provides science lessons as does a biology teacher. Each conveys content, skills, and attitudes that are part of a district science program.
—The program is the basis for selection and development of instructional materials.
—It is the basis for district-wide financial and educational decisions about objectives and assessment, instructional methods and materials, grouping arrangements, time allocations, teacher in-service and supervision.
—It provides for systematic assessment of student achievement.
—It ties together the critical elements of learner outcomes, instructional methods and materials, and assessment.
—It ensures a consistency of learning experiences for all students.
—It ensures that the teachers' creative efforts and unique contributions to students are made part of a larger design.

Characteristics of an Elementary Science Program

An elementary science program has the following characteristics:

- It is a written document.
- It has form, purpose, and direction.
- It is based on the district philosophy.
- It contains a statement of philosophy regarding science education for the district.
- It contains goals, or learner outcomes, expected to be achieved at the end of elementary school. For science, the learner outcomes should address inquiry skills, science attitudes, science principles, and problem-solving processes.
- It provides a scope and sequence of content, skills and attitudes that the classroom teacher can use for instructional purposes.
- The content, skills, and attitudes are articulated, with middle and senior high school science programs, that is, they fit into a systematic whole, K- 12.
- It provides for districtwide assessment practices at appropriate points on a Pre-K through 12 continuum.
- It provides for assessment at the classroom level.
- It provides opportunities for the classroom teacher to use his or her creativity to increase student achievement.
- It enables a classroom teacher to direct instruction toward the achievement of specific outcomes.
- It ensures that students are not taught the same thing twice or not at all. It ensures that each classroom unit or lesson has a purpose, is measureable, and is part of a continuum of learning.

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